Underground Laboratory Options and Realities at Homestake

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for the Homestake Collaboration
University of California, Berkeley
7 March, 2006

Workshop on Long Baseline Neutrino Experiments
March 6-7, 2006

Outline of Homestake Presentation

- History of Homestake and Underground Science

- Progress in Establishing a State Funded Interim Laboratory at Homestake

- Description of the Interim Facility at 4850, plans for optimizing infrastructure, growing into DUSEL

- Near-term, Real Options for a Long Baseline Neutrino Program to Homestake

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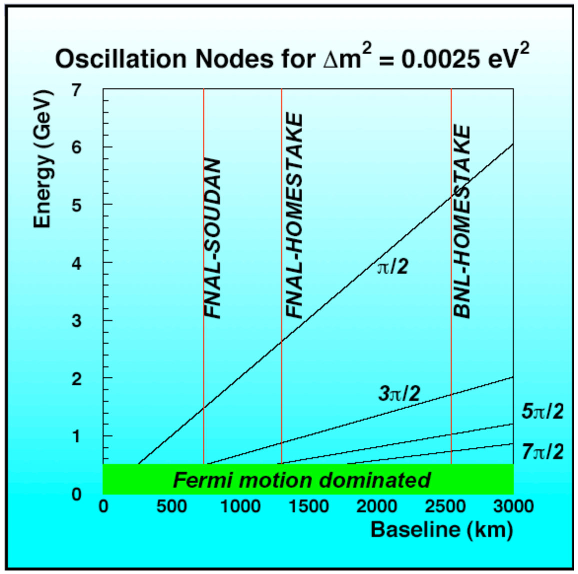

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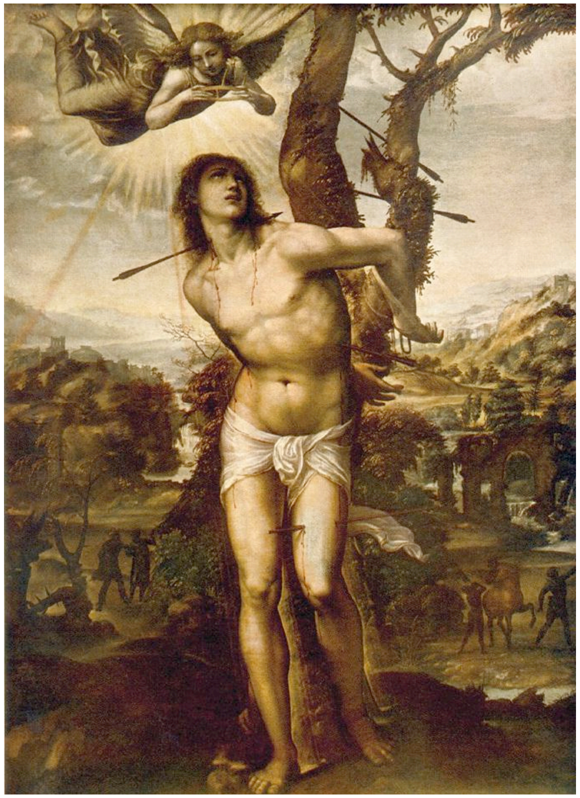
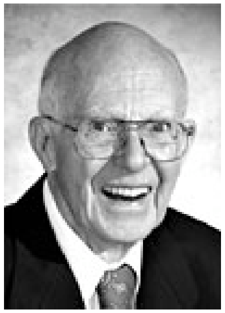


History and Progress in Establishing Interim Facility

- 2001 Homestake was selected by the Bahcall Committee as the prime site for NUSEL: fastest time to science and lower initial capital outlay, strong beneficial impact on local community, lower risks



- 2002 Nobel Prize awarded to Davis for his Chlorine Experiment at Homestake's 4850 level.

- Homestake was again selected in May 2003 by the NSF as the prime site for DUSEL by an independent panel siting report

- Spring 2003 Barrick closed, capped and sealed Homestake:
  - Clean up and and closure documentation by EPA
  - Mothballed surface equipment, preserved many spares and infrastructure components: lifts, cages, transformers, surface buildings, pumps…

  - Ventilation of the mine altered to preserve infrastructure
  - Pumping ceased, accumulation of water in the mine started, Spring 2003, *current level ~ 6200 level (Jan 2006), ~ 750 gal/min in, 2100 to 2500 gal/min pumping capacity*
  - Education Program: flooded mine is a not a fundamental problem for obtaining or maintaining underground access

- Jan 2004, “Agreement in Principle” between Barrick and SDSTA to transfer mine
- Feb 2004, SD legislature enacts enabling and appropriation legislation to effectuate the transfer and provisions in the “Agreement”
  - Created Authority with $100M bonding ability
  - Enacted Indemnity and Immunity Statutes
  - Funded $14.3M (+ $10M from HUD action)
- March 2004, New NSF 3 step process announced, previous siting report voided. Process had “stalled” flooding of the mine put forward as the reason to void decision

- Dec 2004, SDSTA Conversion Plan Vetted by panel of scientists and mining experts
- Feb 2005 Barrick confirms 4850 lab satisfies the "Agreement"
- July 2005 Henderson and Homestake selected by NSF, each funded for CDR work
- Aug 2005, transferable water permits renewed by Barrick
- September 2005, Agreement with Barrick amended to conform to 4850 lab
- October 2005, State Legislature approves additional \$20M funding for Homestake, total of \$45M from state controlled sources.

- Dec 2004, SDSTA Conversion Plan Vetted by panel of scientists and mining experts
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- Aug 2005, transferable water permits renewed by Barrick
- September 2005, Agreement with Barrick amended to conform to 4850 lab
- October 2005, State Legislature approves additional $20M funding for Homestake, total of $45M from state controlled sources.

- November 2005 - First call for Letters of Interest for Homestake ~ 80 letters received by February 2006
- December 2005 - two workshops at AGU in San Francisco and town meeting.
- 9 February 2006 - Physics and E&O workshops held in Lead, SD, ~ 135 attendees
- 10 - 11 February 2006 - 1st PAC meeting for Homestake, LOIs present written documents and oral presentations to the PAC

neutrino.lbl.gov/Homestake/FebWS

Letters of Interest for Homestake

- ~ 80 LOIs clocked in
- ~ 60% earth science
- ~ 20% physics
  - dark matter
  - double beta decay
  - geoneutrinos
  - long baseline + pdk
  - low bckgrd cnting
  - n-nbar
  - astrophysics
- ~ 5% engineering
- ~ 5% education
- ~ other

Plan for science and infrastructure needs

#	Date Received	Title	Discipline
1	11/21/05	Time Dependent Deformation	Rock Mechanics
2	11/21/05	Scale Effects In Rock Mechanics	Rock Mechanics
3	11/21/05	Stress & Rock Properties of the Yates member of the Poorman Formation	Rock Mechanics
4	11/22/05	Mine Engineering & Management Related Activities	Mining
5	11/23/05	DUSEL Education & Conference Center	Education & Outreach
6	12/2/05	Determination of Water Levels & Stress Release during Dewatering	Geology
7	12/2/05	Search for Neutron-Antineutron Transition at Homestake	Physics
8	12/6/05	Plan for Near Future of High Energy Neutrino Physics at Homestake	Physics
9	12/8/05	Hard Rock Underground Mine Mapping & Surveying	Geology
10	12/8/05	Partitioning of CO2, H2O, gold and trace metals between synformal and antiformal fold hinges	Geology
11	12/8/05	Developing an Internet-accessible database of 3D geologic and engineering data	Geology
12	12/8/05	Hydrologic Instrumentation of the Homestake DUSEL	Geology
13	12/9/05	New Paradigms in Sensing	Engineering
14	12/9/05	Effects of Ultralow Radiation Levels on Human Cells	Microbiology
15	12/9/05	Microbial Evolution	Microbiology
16	12/9/05	Workshops	Education & Outreach
17	12/1/05	Effects of Cosmic Rays on the Soft Error Rate of Semiconductor Memory Chips at Ground Level	Engineering
18	12/2/05	Controls on World-Class Homestake Gold Mineralization	Geology
19	12/8/05	Low Radioactivity Measurement Laboratory	Low Backg. Counting
20	12/9/05	Role of Iron Formations in the Making of Giant Gold Deposits	Geology
21	12/9/05	Thermal History of Homestake Mine	Geology
22	12/9/05	Super CDMS	Physics
23	12/9/05	Determination of Diurnal changes in the rotation rate of the earth	Physics
24	12/9/05	Establishing the Physical Footprint for Future Geoscience Research at DUSEL	Geology
25	12/9/05	Developing of a robotic sampler for underground and confined environments	Engineering
26	12/10/05	Homestake Electrical Engineering Laboratory (HEEL)	Physics
27	12/10/05	Homestake Outreach Program (HOP)	Education & Outreach
28	12/10/05	Bioprospecting	Microbiology
29	12/10/05	Analysis of soil-like materials in the mine	Geology
30	12/10/05	Biological effect of low levels of radiation-Health Physics	Microbiology
31	12/10/05	Homestake Neutrinos	Offer to Collaborate
32	12/10/05	Establishing baseline data for microbial populations of the mine before and after dewatering	Microbiology
33	12/12/05	Cloud physics facility and experiments for an underground laboratory	Atmospheric sciences
34	12/11/05	Fracture network characterization at Homestake	Rock Mechanics
35	12/11/05	Risk Assessment of underground space modifications at Homestake	Rock Mechanics
36	12/11/05	Hydrogeology Collaboration on flow path delineation and modification	Earth Sciences
37	12/11/05	Geochemistry collab. for the geochemical evolution of fluids in the Homestake hydrologic system	Earth Sciences
38	12/11/05	Ecology/geomicrobiology collaboration for microbe evolution	Earth Sciences
39	12/11/05	Geophysics collaboration for imaging	Earth Sciences
40	12/11/05	Rock Mechanics and geoengineering collaboration for excavation research	Earth Sciences
41	12/11/05	Couple process collaboration for large block experiments	Earth Sciences
42	12/11/05	Cosmic ray studies	Earth Sciences
43	12/12/05	Characterization and mechanics of faulting and rock fracture at homestake mine	Rock Mechanics
44	12/12/05	Breccia evolution associate with degassing of tertiary veins and dikes at Homestake	Geology
45	12/12/05	Development of a 3D geological model of the Homestake mine area	Geology
46	12/12/05	Detailed geological mapping of the Homestake mine area	Geology
47	12/12/05	Close range remote sensing for mapping of rock in underground excavations	Geology
48	12/12/05	ZEPLIN - a multi ton scale liquid xenon dark matter direct search program	Physics
49	12/12/05	EXO - the enriched xenon observatory for neutrino-less double-beta decay	Physics
50	12/12/05	Educational outreach support infrastructure	Education & Outreach
51	12/12/05	Low-alpha lead and the cosmic-ray equivalency factor	Physics
52	12/12/05	Study of a LANNDD of 100kTon at Homestake DUSEL	Physics
53	12/13/05	Investigation of microbial diversity in subsurface ecosystems	Microbiology
54	12/13/05	Initial low background counting facilities for Homestake	Physics
55	12/14/05	Large block (Pillar) test to study the failure of rock - rock strength and earthquake mechanics	Rock Mechanics

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Homestake PAC: 2006

Physics

Frank Sciulli - Columbia Co-chair

Ed Kearns - BU

Josh Klein - U. Texas

Bill Marciano - BNL

Harry Nelson - UCSB

Hank Sobel - UCI

Earth Science

Derek Elsworth - Penn State Co-chair

Sookie Bang - SDSM&T

Derric Iles - SD GS

Thomas L. Kieft - New Mexico Institute of Mining and Technology

Chris Neuzil - USGS

Bill Pariseau - Utah

Education and Outreach

Charles Ruch - SDSM&T

9

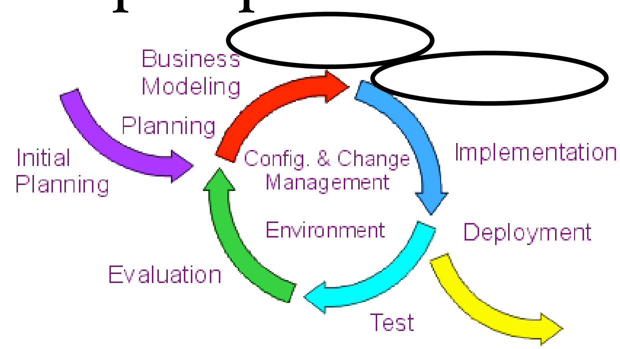
Early Implementation Program and the Homestake State Facility

- Progress in Developing Homestake
  - Title
  - Reentry
  - 4850 Lab
  - Design of the Deep Lab

South Dakota Science & Technology Authority (Landlord): Conversion Plan

NSF Responses & Homestake Collaboration

- Development of Science Opportunities at Homestake
  - 4850 Lab || Deep/Expanded Lab
    - Astrophysics and Physics
    - Earth Sciences and Geosciences
    - Biology
    - Engineering
    - Outreach and Education



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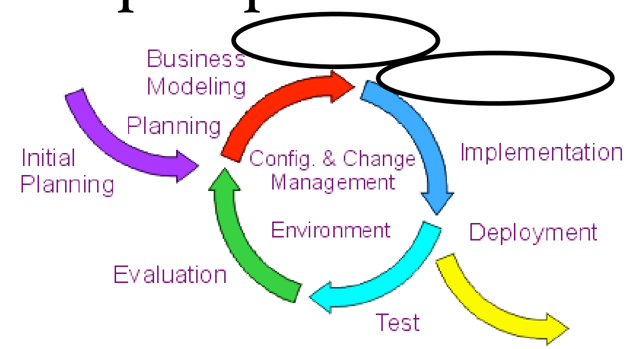

Initial Uses in 2007

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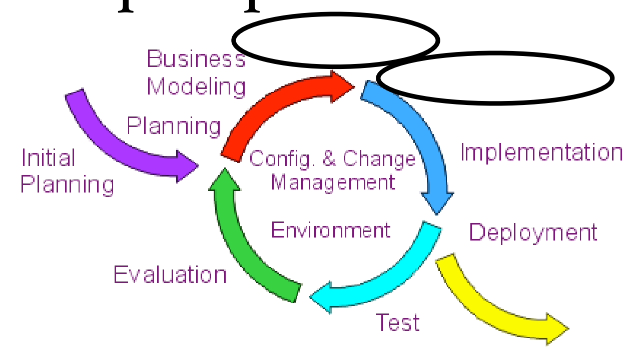
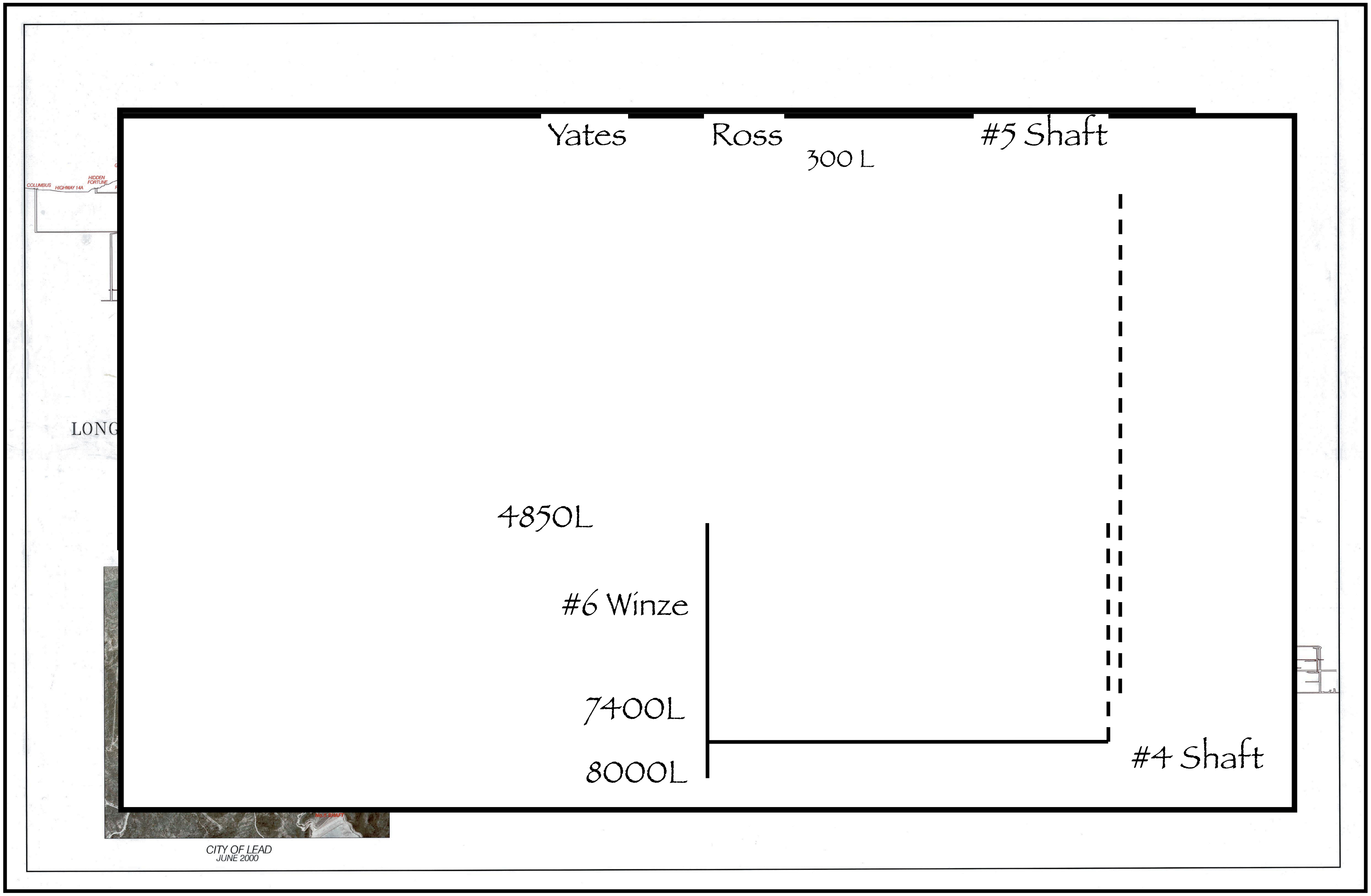


Initial Uses in 2007

Expanded Uses in 2008/2009 as DUSEL

De-watering & Rehabilitation, Access to Deep Levels for Transition to DUSEL Construction and Lab Operations



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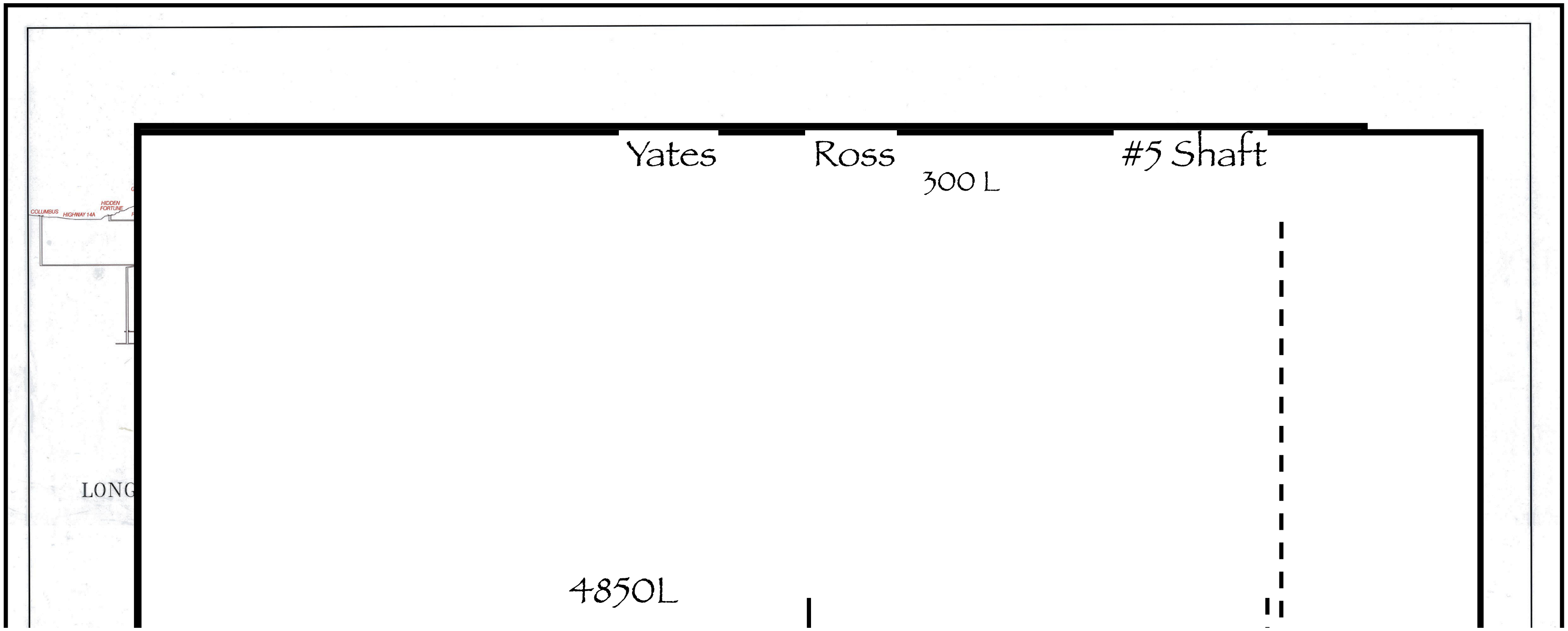
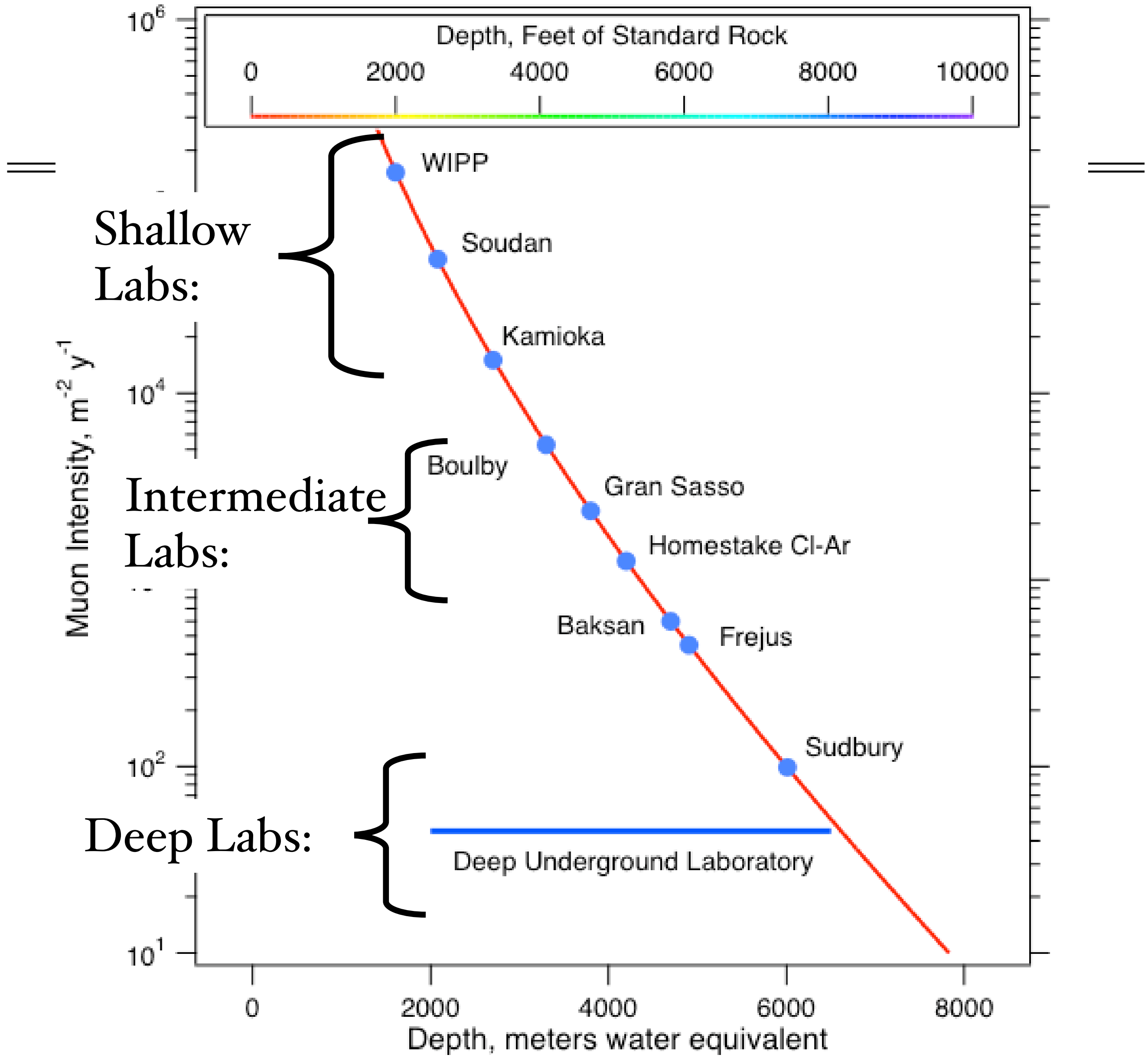
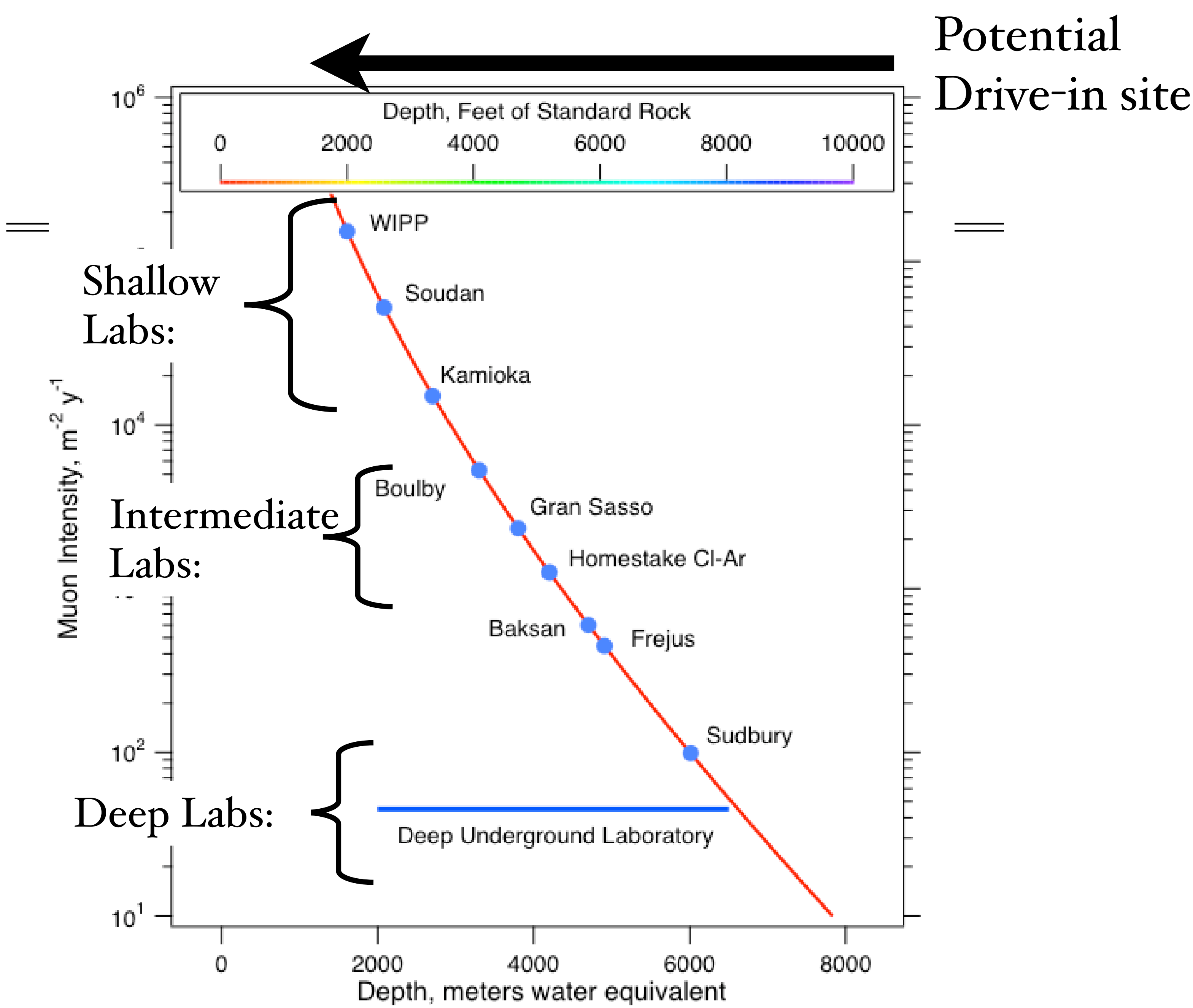


- Reentry consists of rehabilitating Yates and Ross Shafts and conveyances
- Establishing safety program
- Collecting and pumping 2/3 of the incoming water (surface water)
- Install pumps to ensure water does not rise above 5300 (currently ~ 6200)
- Conversion of Surface buildings
- Develop 4850 level for science, and upper levels as needed (see next)
- Staffing of the SDSTA to <u>operate</u> and <u>maintain</u> the Site


Depth, Feet of Standard Rock
0
2000
4000
6000
8000
10000
WIPP
Soudan
Kamioka
Boulby
Gran Sasso
Homestake Cl-Ar
Baksan
Frejus
Sudbury
Deep Underground Laboratory
Shallow Labs:
Intermediate Labs:
Deep Labs:
Muon Intensity, m^{-2} y^{-1}
10^6
10^4
10^2
10^1
0
2000
4000
6000
8000
Depth, meters water equivalent


Potential
Drive-in site
Depth, Feet of Standard Rock
0 2000 4000 6000 8000 10000
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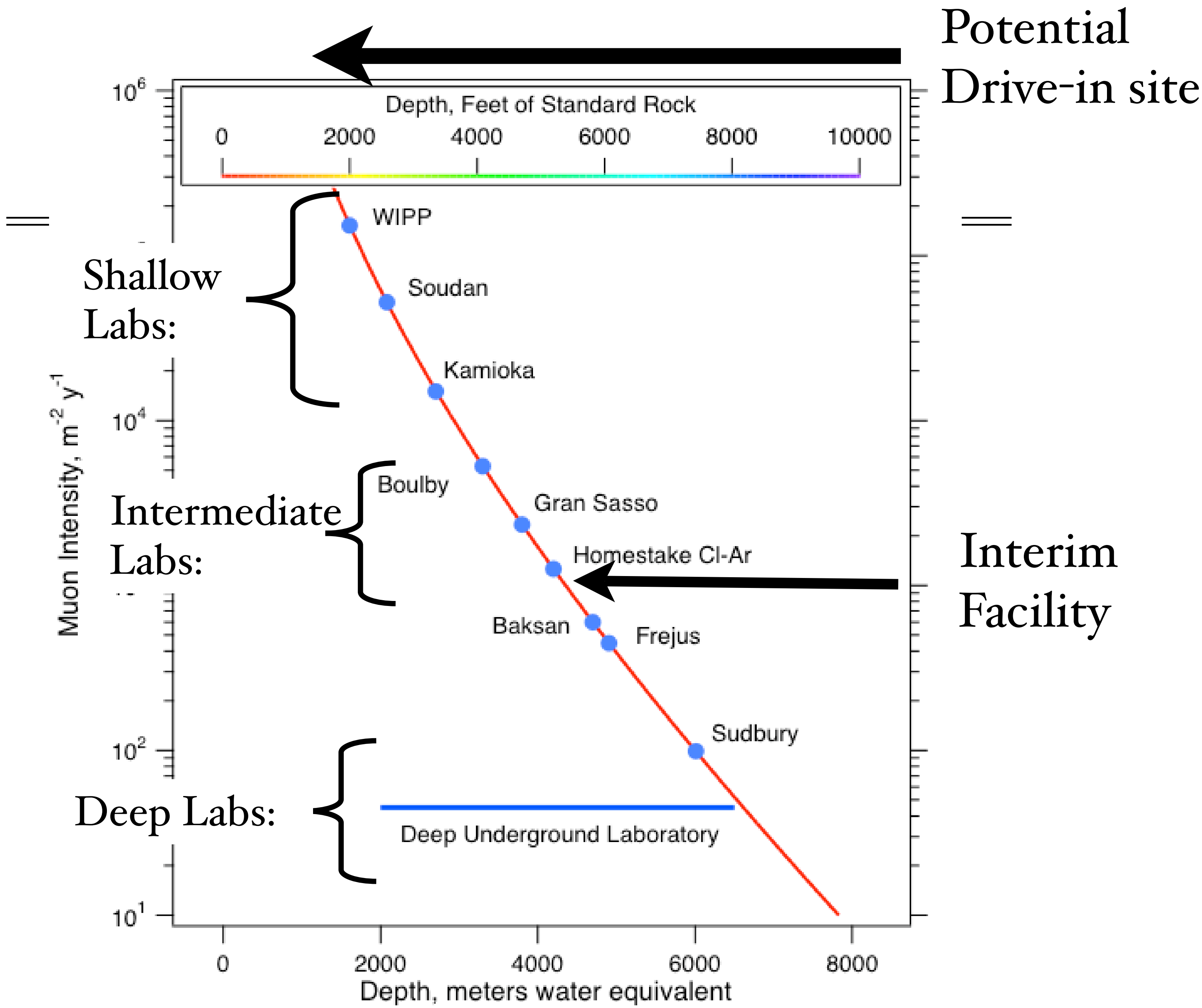

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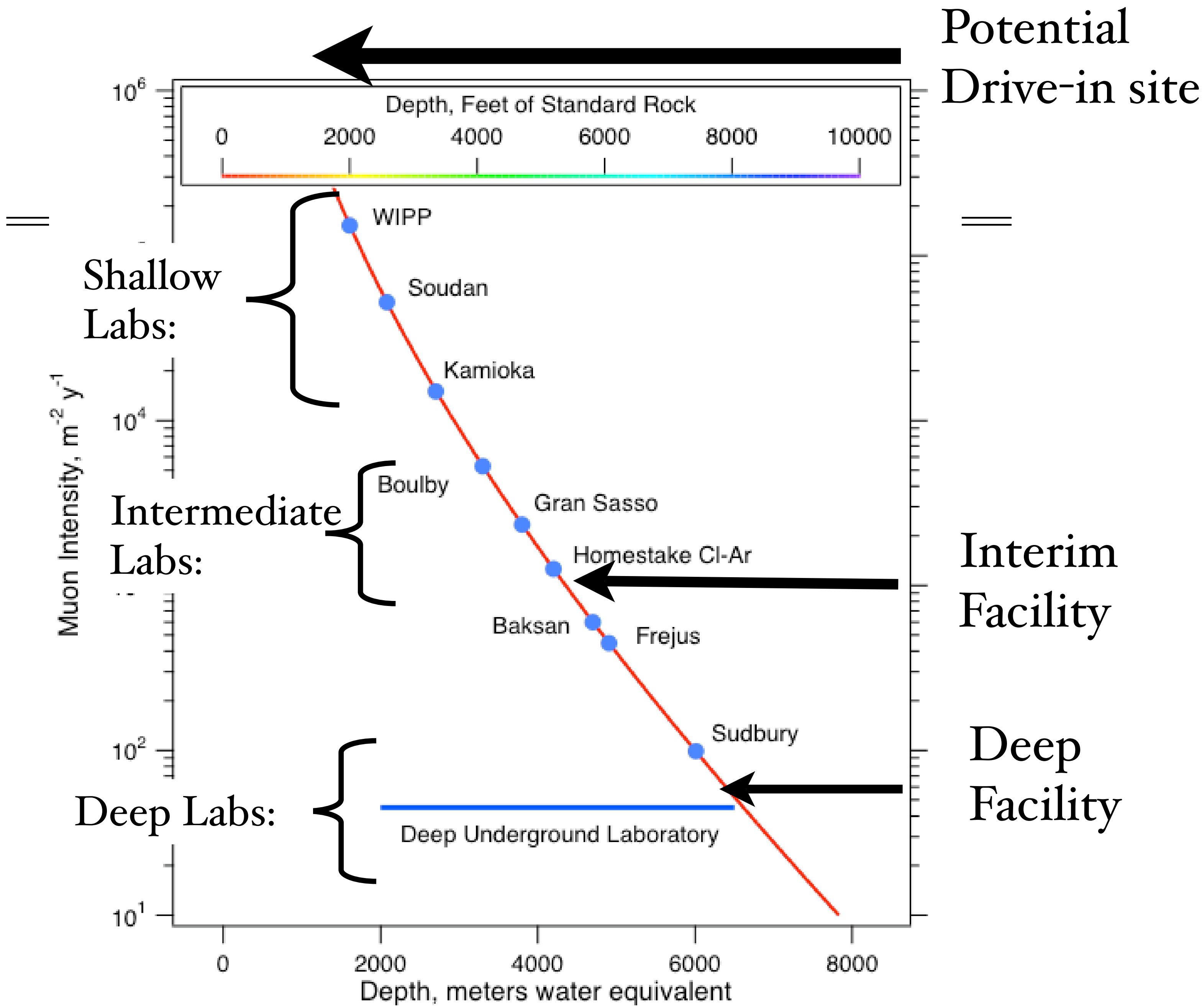
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Interim Facility
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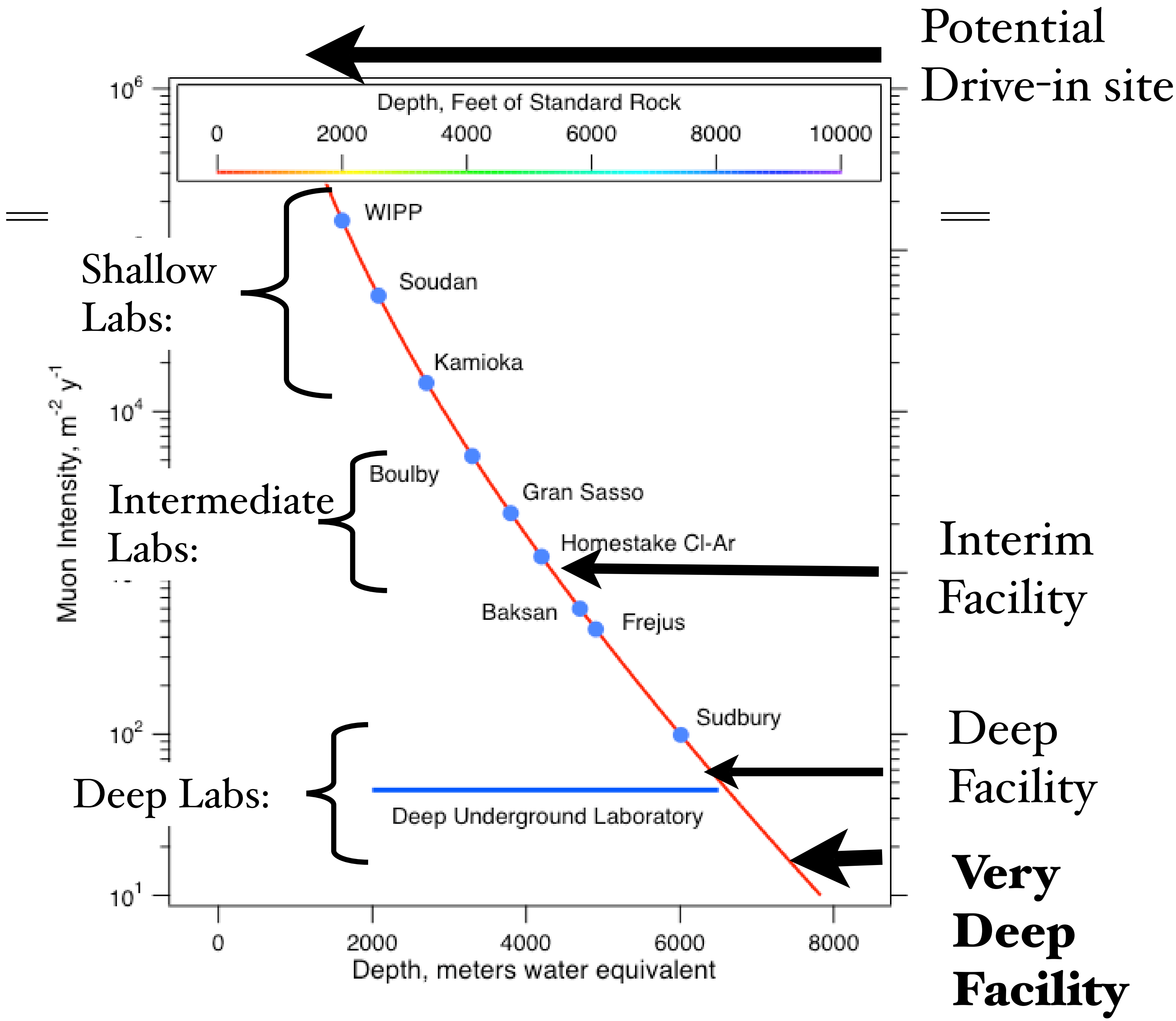

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Deep Underground Laboratory
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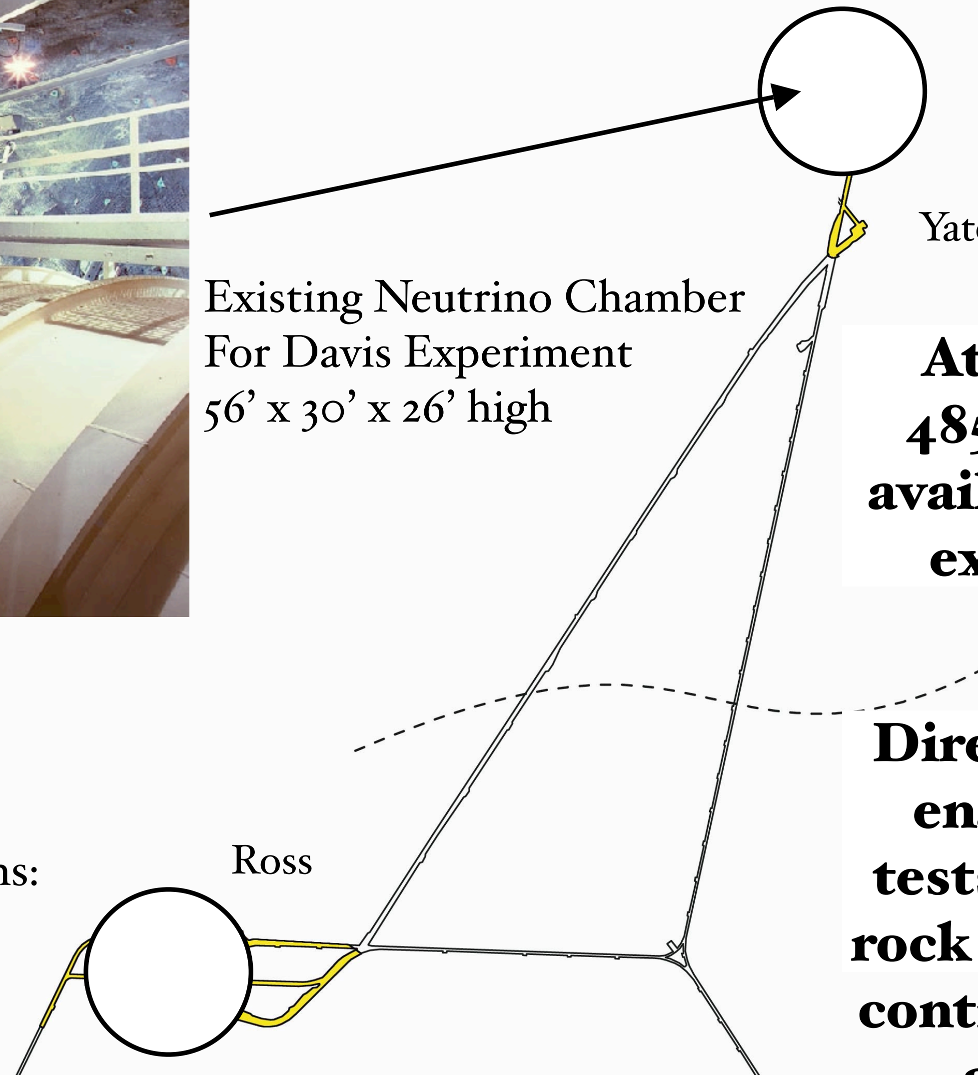
Intermediate Labs:
Deep Labs:
Interim Facility
Deep Facility
Very Deep Facility
Muon Intensity, m^{-2} y^{-1}
10^6
10^4
10^2
10^1
Depth, meters water equivalent

4850L Re-Entry Phase

Existing Neutrino Chamber
For Davis Experiment
56’ x 30’ x 26’ high



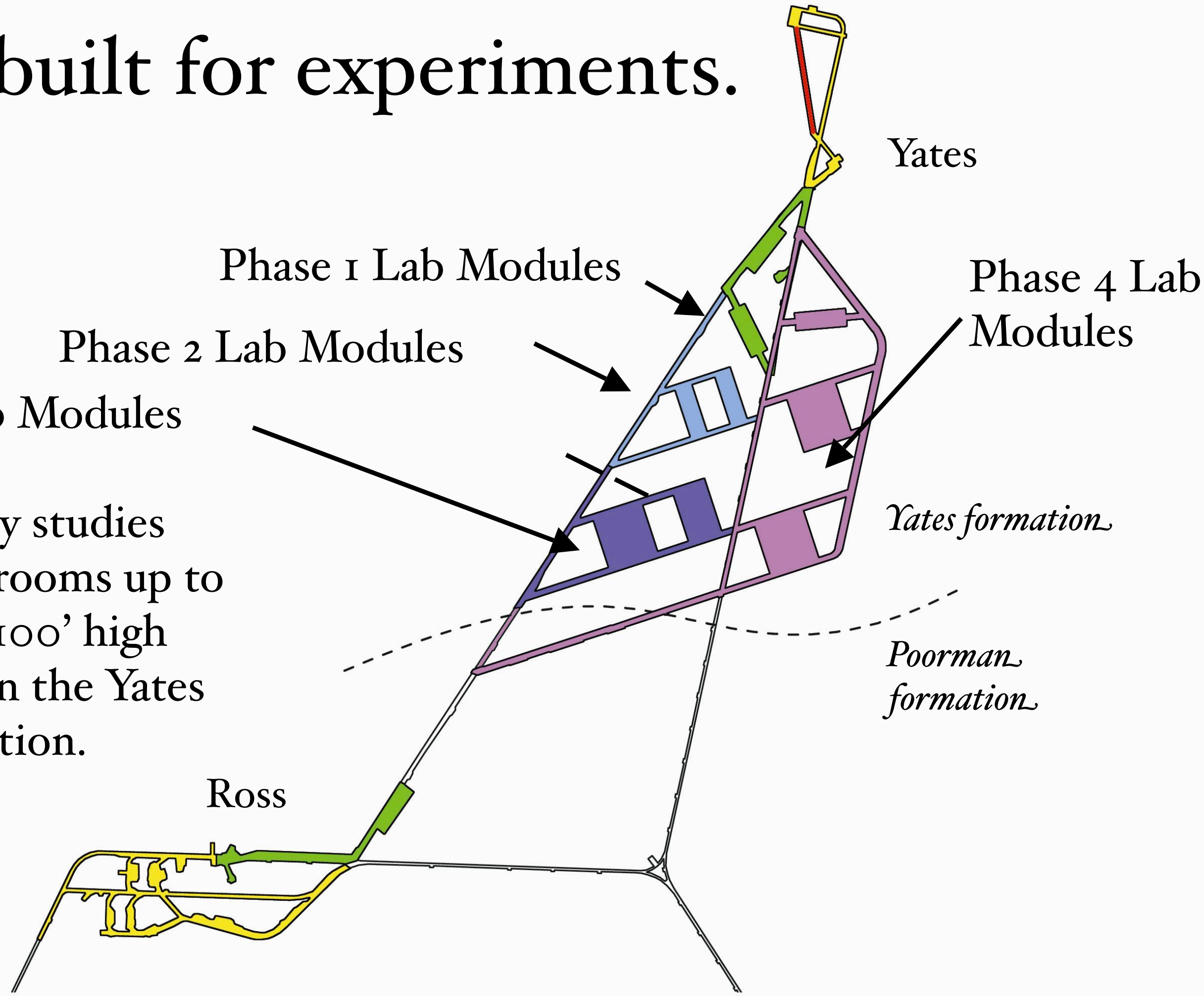
At re-entry to 4850L, space is available for early experiments.

Direct access will enable further tests and study of rock properties for continued analysis and design

4850L Shops
Existing Rooms:

60’ x 20’ x 9’
50’ x 25’ x 9’
70’ x 50’ x 9’
50’ x 30’ x 9’

4850L Phased Development of additional lab modules purpose-built for experiments.



Preliminary studies indicate that rooms up to 150' dia. x 100' high are feasible in the Yates Formation.

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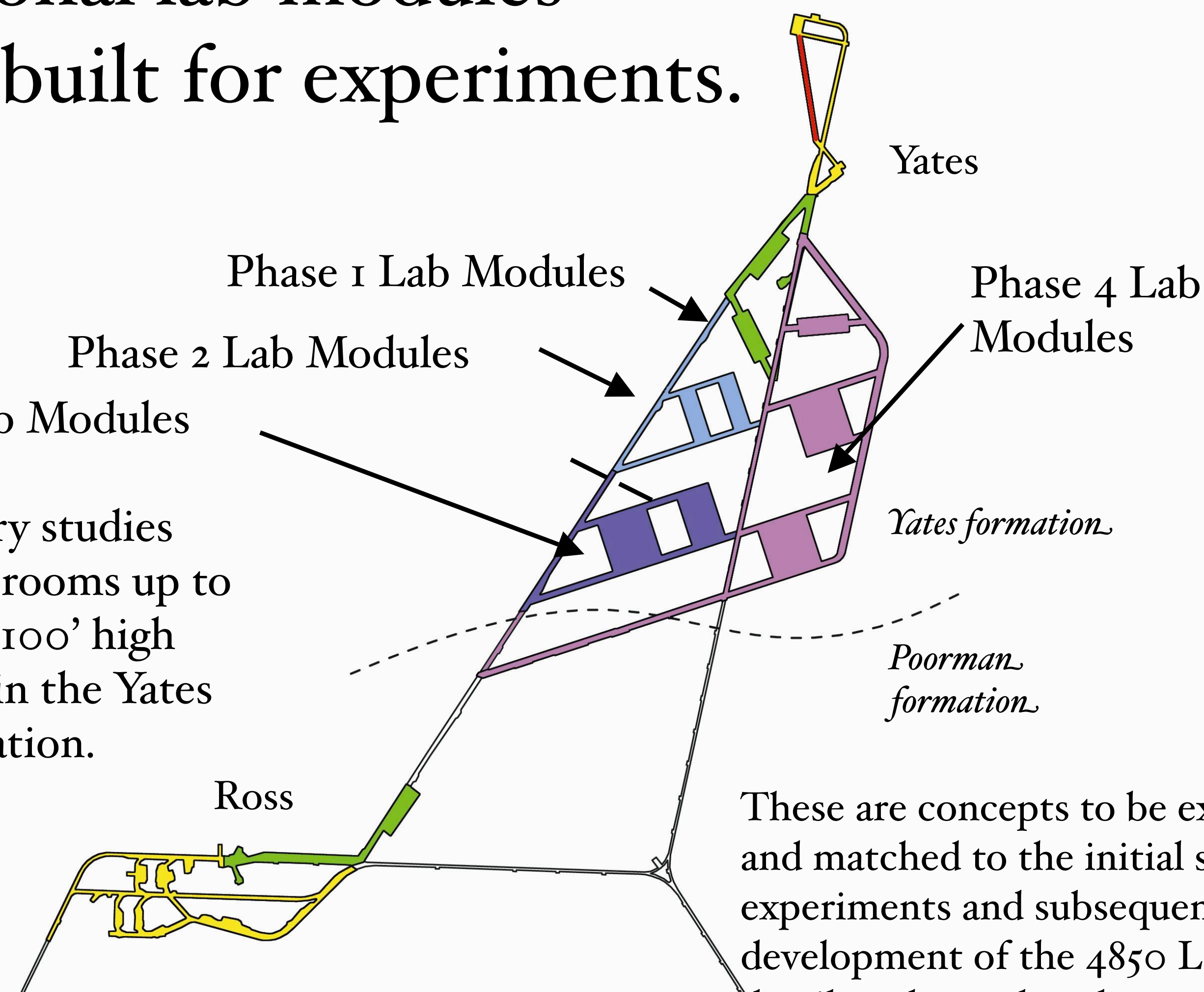
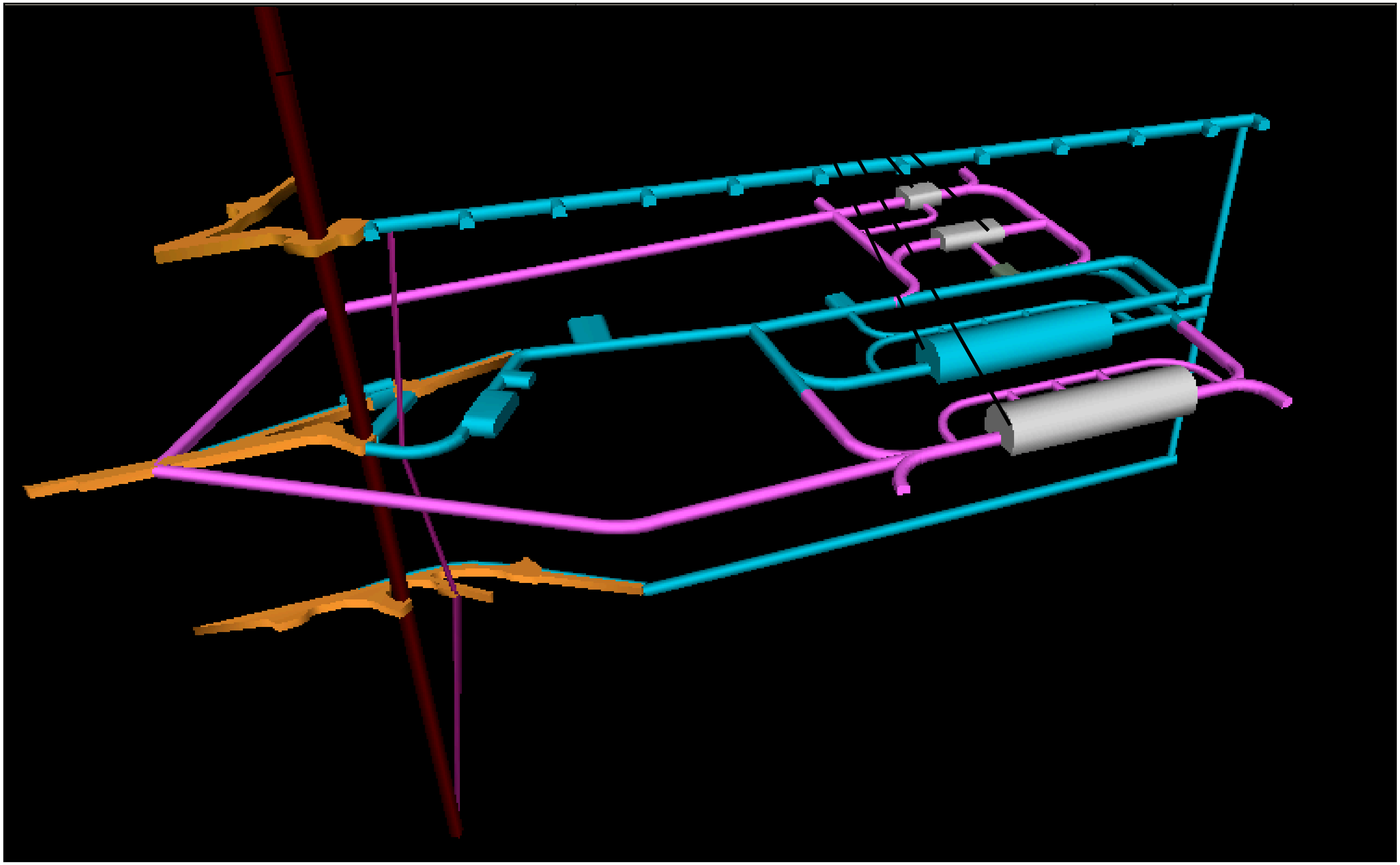


Preliminary studies indicate that rooms up to 150’ dia. x 100’ high are feasible in the Yates Formation.

These are concepts to be explored and matched to the initial suite of experiments and subsequent development of the 4850 Lab, details to be analyzed as part of CDR and TDR

Possible 7400L Campus Phased Development
Earlier Analysis performed in 2004, included in Dynatec Report, including initial Golder study of cavities at depth



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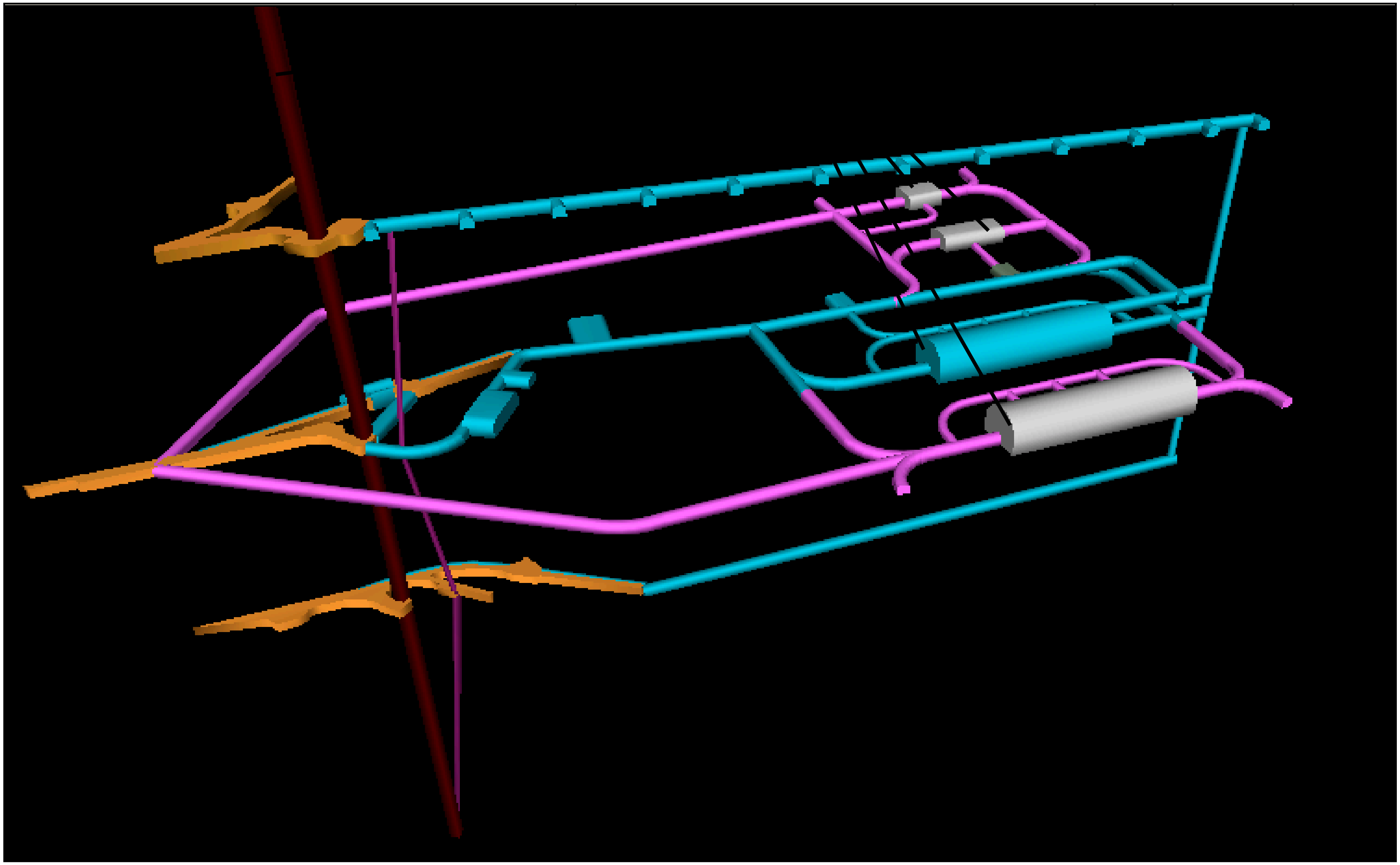
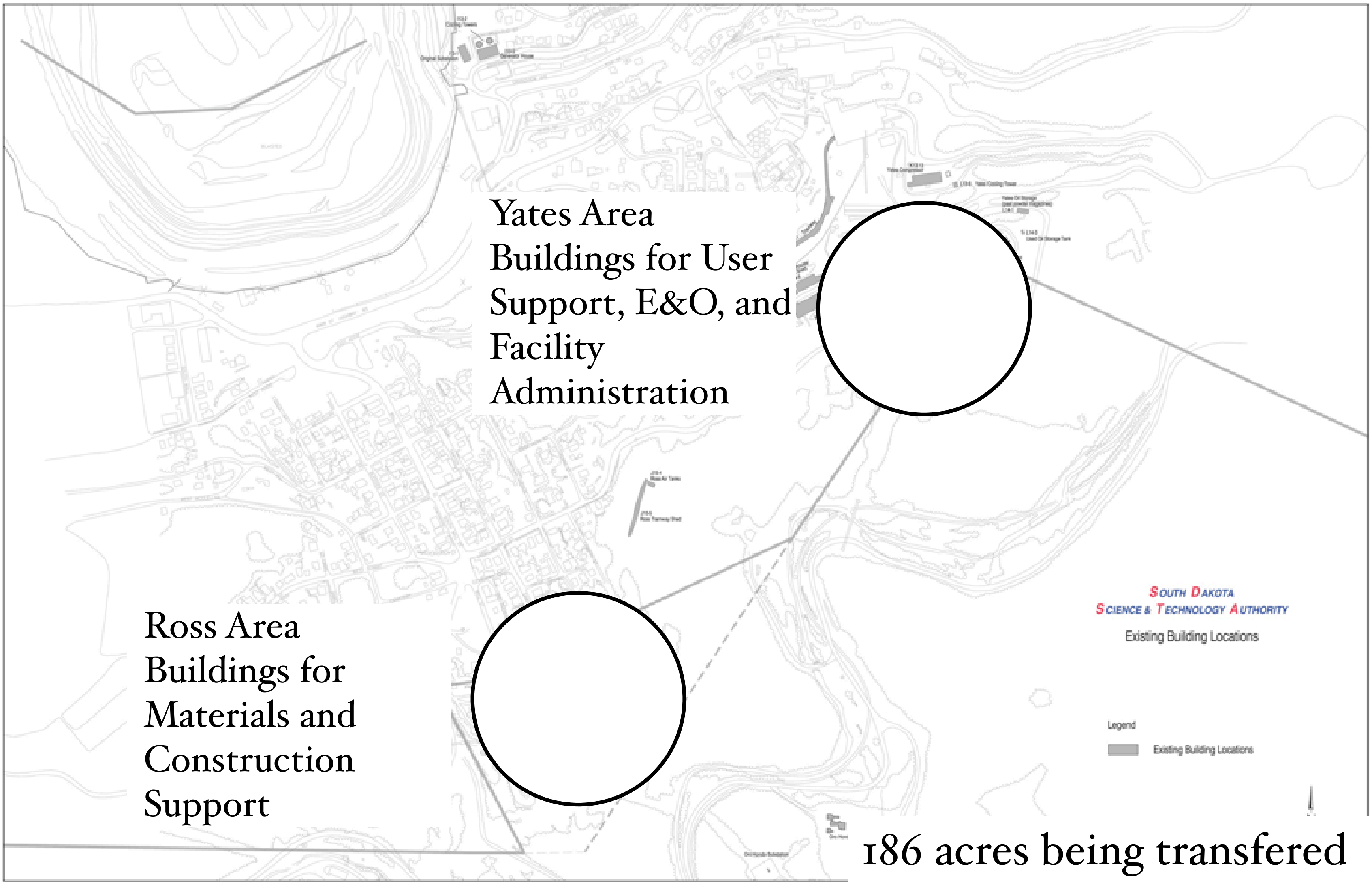


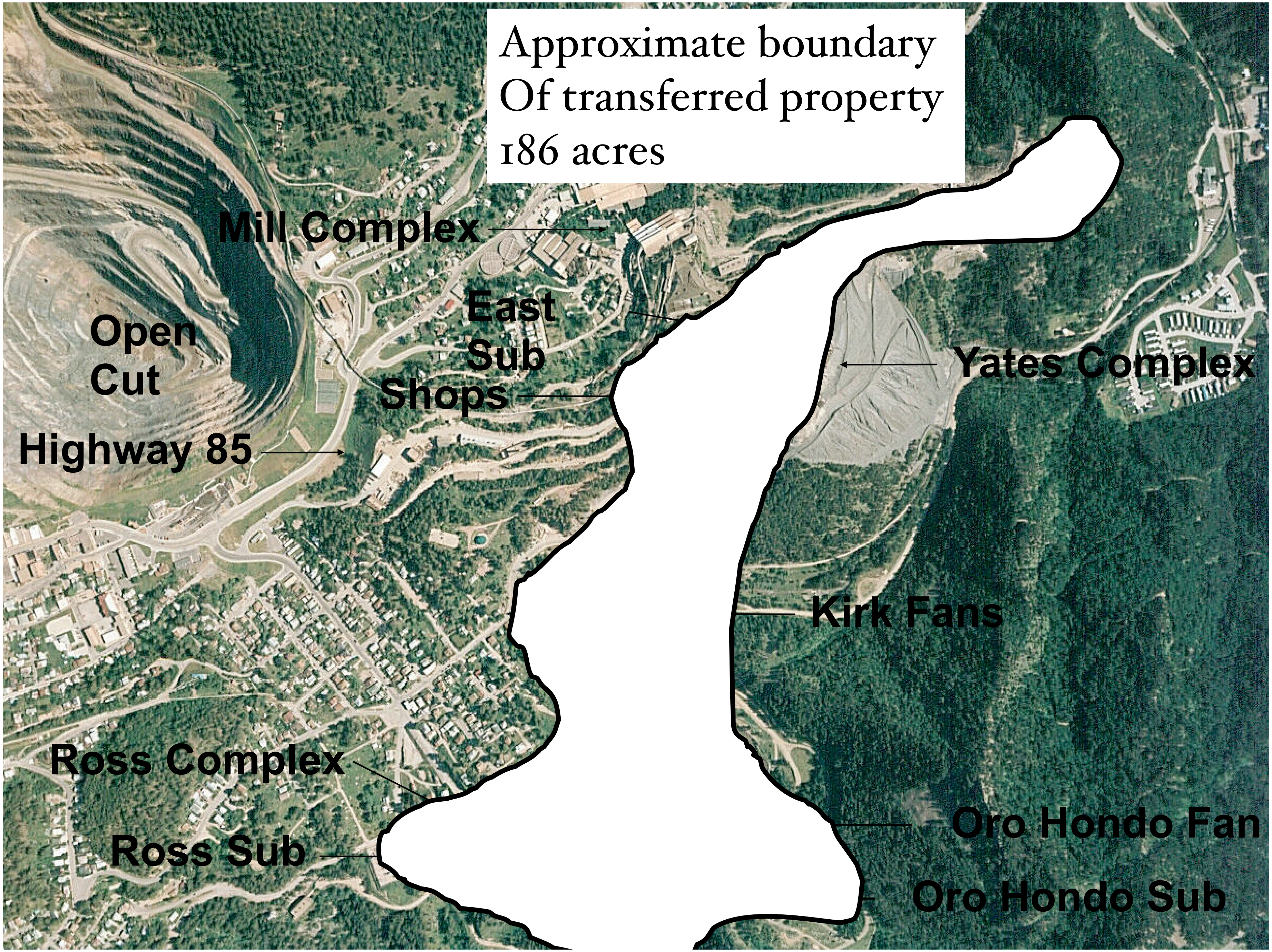
Existing Surface Buildings for Facility Operations and Support included in the Agreement



Yates Area
Buildings for User Support, E&O, and Facility Administration

Ross Area
Buildings for Materials and Construction Support

186 acres being transfered


Approximate boundary
Of transferred property
186 acres
Mill Complex
Open
Cut
East
Sub
Shops
Yates Complex
Highway 85
Kirk Fans
Ross Complex
Ross Sub
Oro Hondo Fan
Oro Hondo Sub

Status of Property Transfer

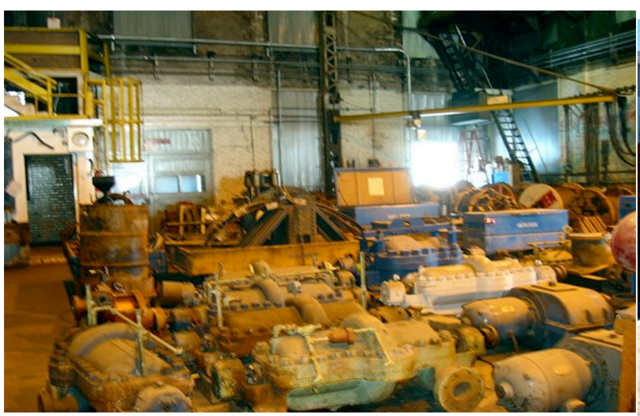
- ☑ Survey and plats completed and approved
- Property Donation Agreement **drafted** and under review and (final) edits
  - Original document: no precedence
  - Many parties involved and many *needs*
  - Very complicated
  - Must be accurate and **enduring**
- ☑ Shared use agreement is completed several years)

SDSTA Actions Following Signing of Agreement

- Close and transfer possession within 30 days of signing agreement (currently anticipated by end of March)
- Prior to closing:
  - Remodel office space
  - Hire staff with Homestake experience
    - Safety officer
    - Mine engineer
    - Operations Supervisor
    - Administrative
  - Transfer all utilities and established services

Most Important

- We (SDSTA) must be CAPABLE to take possession and operate the property in an ABSOLUTELY SAFE manner
- We (SDSTA) must have the qualified and experienced staff in place to operate a mine property with compliance of all regulations and reporting requirements

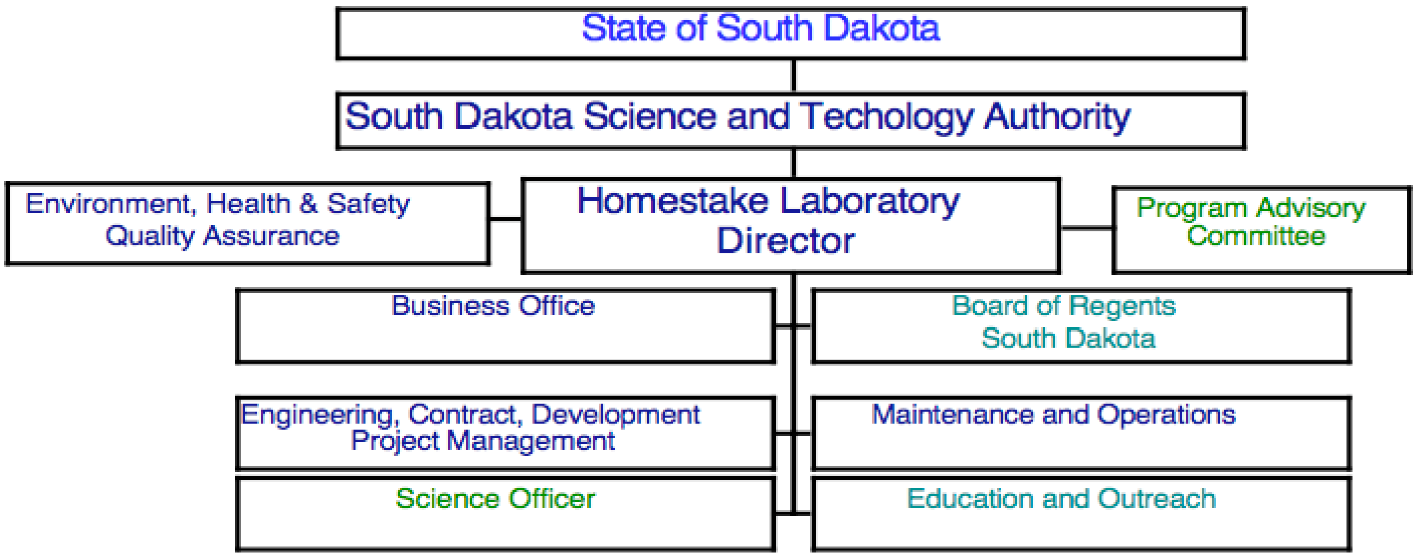


Role of Authority Following *Closing*

- Safe operation of mine & property
- Incorporate PAC recommendations
- Design and engineer rehabilitation
  - Re-establishment of utilities and services
  - Hoists & Shafts
  - <u>Water discharge permits</u> & ID rock disposal sites
  - Development of 4850 Level
    - Support facilities, utilities, access, improvements
    - Room enlargement or modification
    - Convert Yates *dry* to offices and classrooms
- Refine cost estimates of rehabilitation
- Solicit bids for rehabilitation work
- Manage and supervise contracted work
- Operations of infrastructure

2006 until DUSEL

Draft Homestake Laboratory
Interim Management Organization



<u>All Projects will undergo:</u>

safety, environment, hazard review

design and engineering review

science review

<u>Projects will have:</u>

administrative contact

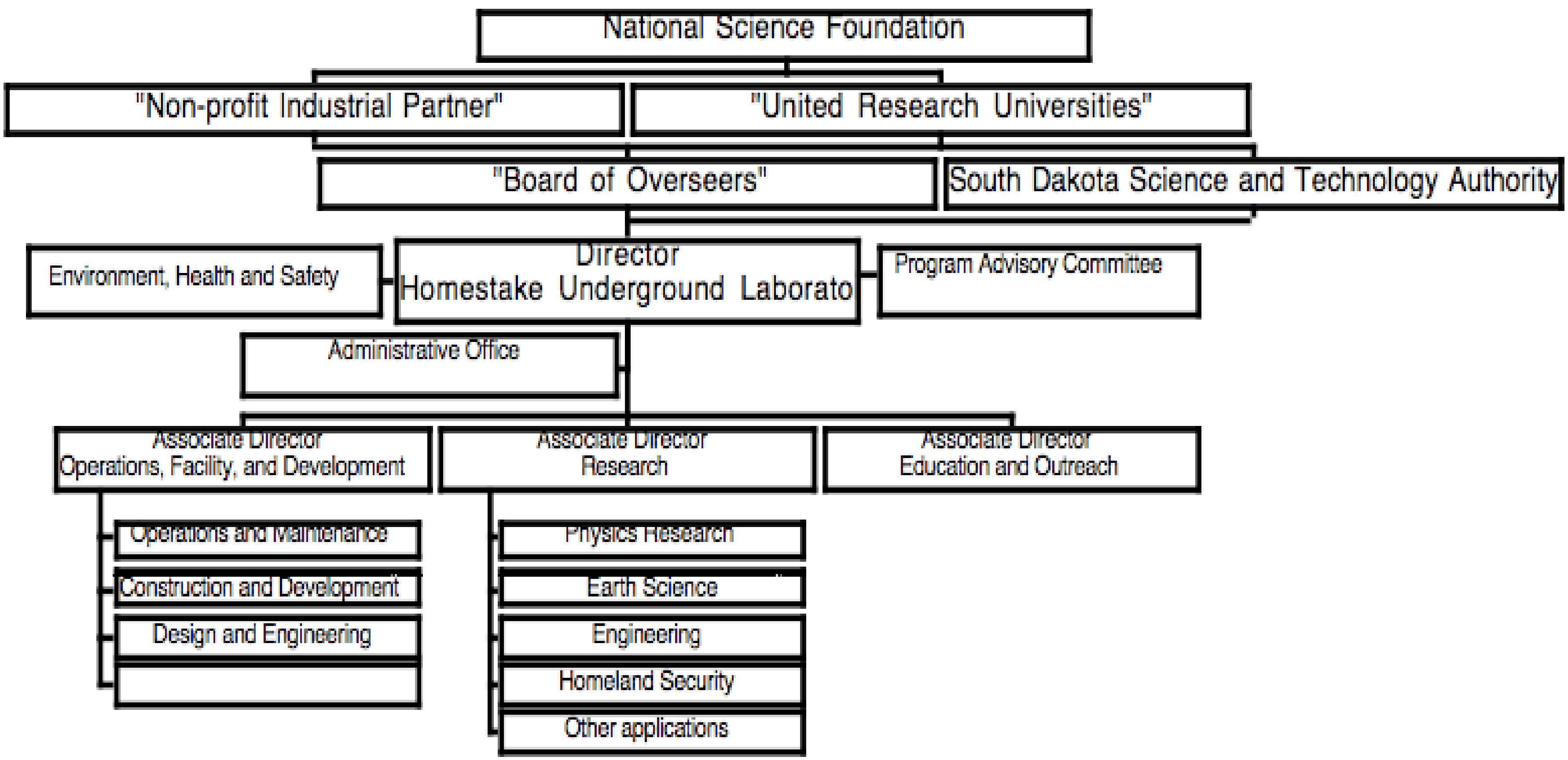
engineering contact

safety contact

science contact

Possible Organization for Homestake - DUSEL

Draft DUSEL Organization (for discussion)



Large Cavities, Homestake & Long BaseLine Neutrino Programs

Existing Studies on Large Room Stability, Evaluations at Homestake, Existence Proofs

- Vertical Crater Retreat (45-61 m high) evaluations, Pariseau *et al.*, BOM, 1985
- 61 m dia. x 122 m cylinders, stable at 4850 and 6800, might not at 8000', Johnson and Tesarik, NIOSH, 2000
- Linear arrays of 50 m dia. x 50 m cylinders with 100 m spacing are stable at 4850', Callahan *et al.*, RESPECT, 2001

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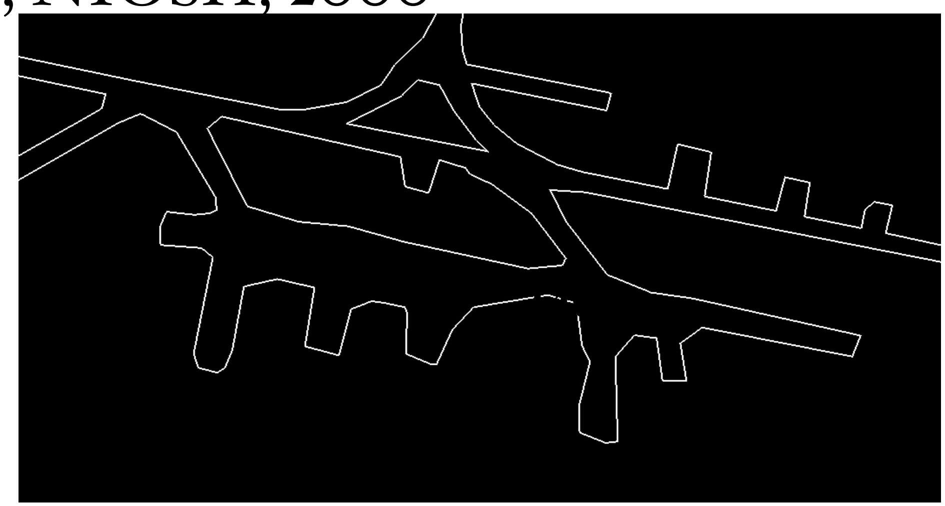
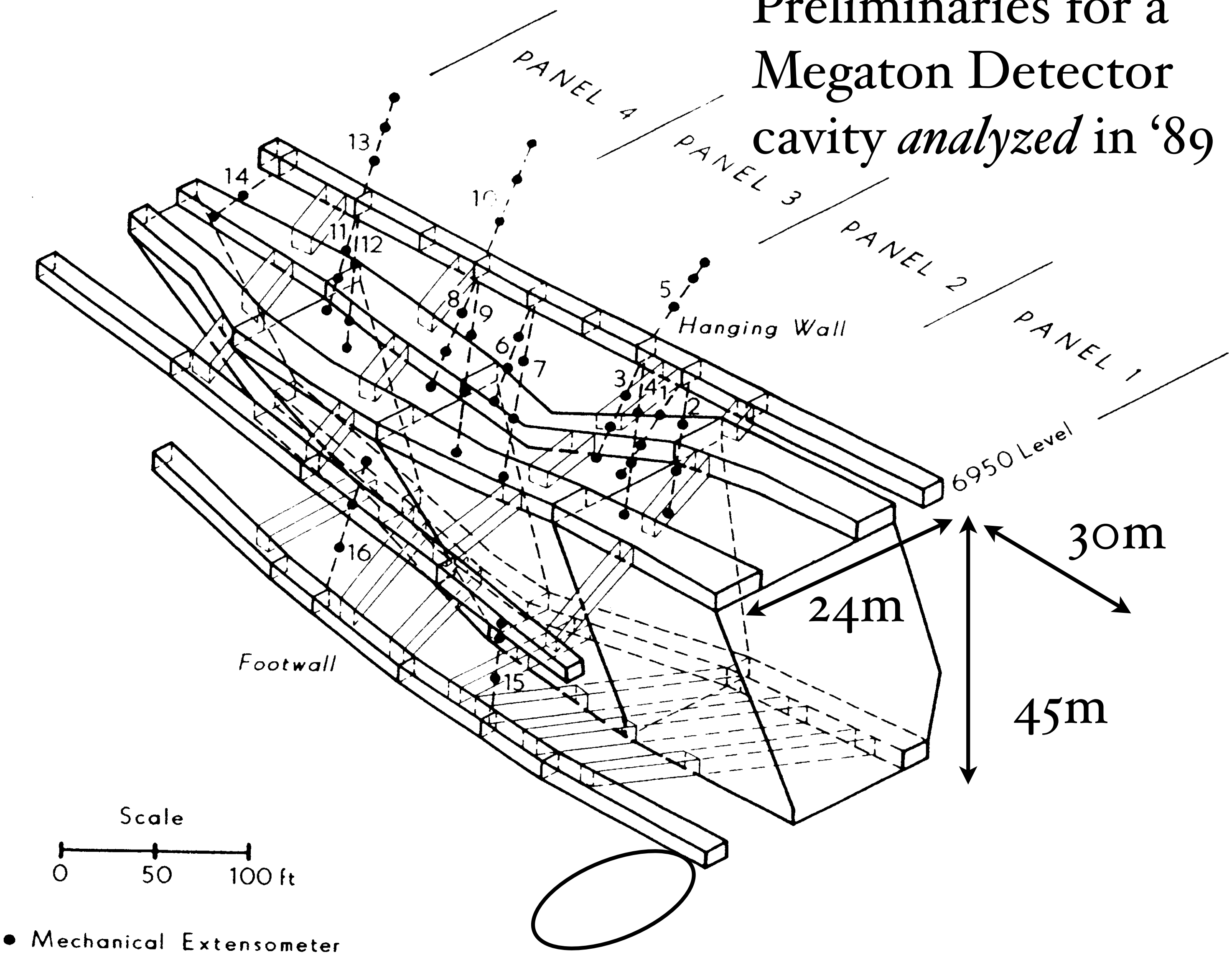


Preliminaries for a Megaton Detector cavity *analyzed* in '89



Pariseau, W.G. and F. Duan (1989) "Finite Element Analyses of the Homestake Mine Study Stope: An Update". Proc. 3rd Intl. Symp. on Numerical Models in Geomechanics. (NUMOG III). Elsevier Applied Science, London and New York, pp 566-576.

Rock Properties

– In Situ Stress Estimation (NIOSH)

$s_v = 1.25\ h$ (vertical psi)

$s_{h1} = 2078 + 0.53\ h$ (dip direction psi)

$s_{h2} = 121 + 0.55\ h$ (strike direction psi)

– Laboratory Rock Properties (psi)

Property	Homestake	Poorman	Ellison	Yates
C_1	20,150	13,630	11,340	N/A
C_2	11,550	10,000	11,410	N/A
C_3	13,270	12,270	8,150	N/A
T_1	1,380	2,990	2,350	N/A
T_2	1,140	820	590	N/A
T_3	1,920	1,910	1,650	N/A

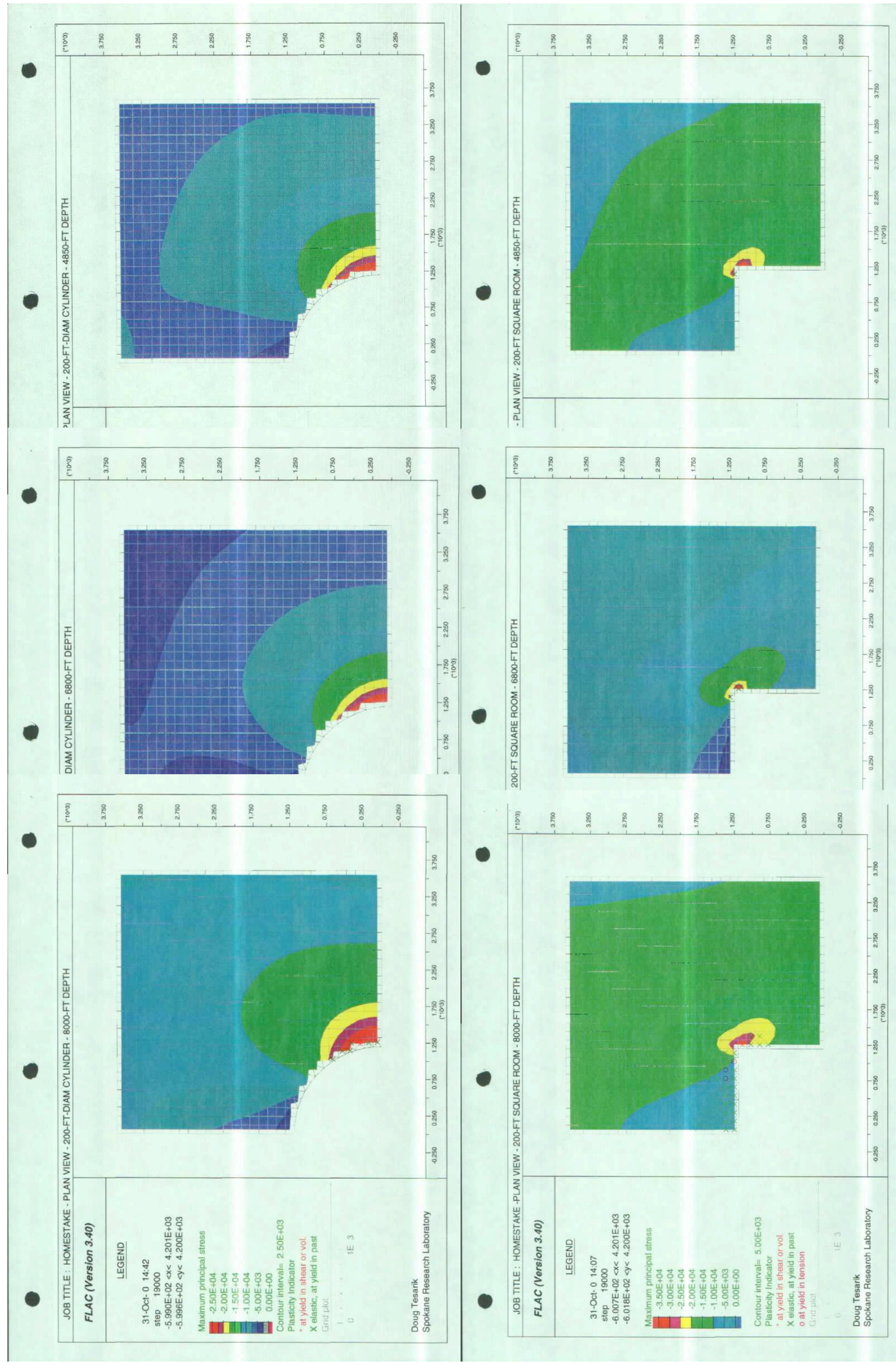
1 & 3 directions are parallel to the schistosity
2 direction is perpendicular to the schistosity

Current activity to analyze core from 4850 Yates formation

Current activity to analyze core from 4850 Yates formation

Johnson and Tesarik, 2000

4850 Level
(max principle stress=1.2x10^4 contours @ 1000)



(1.75x10^4 c 2500)

(2.25x10^4 c 2500)

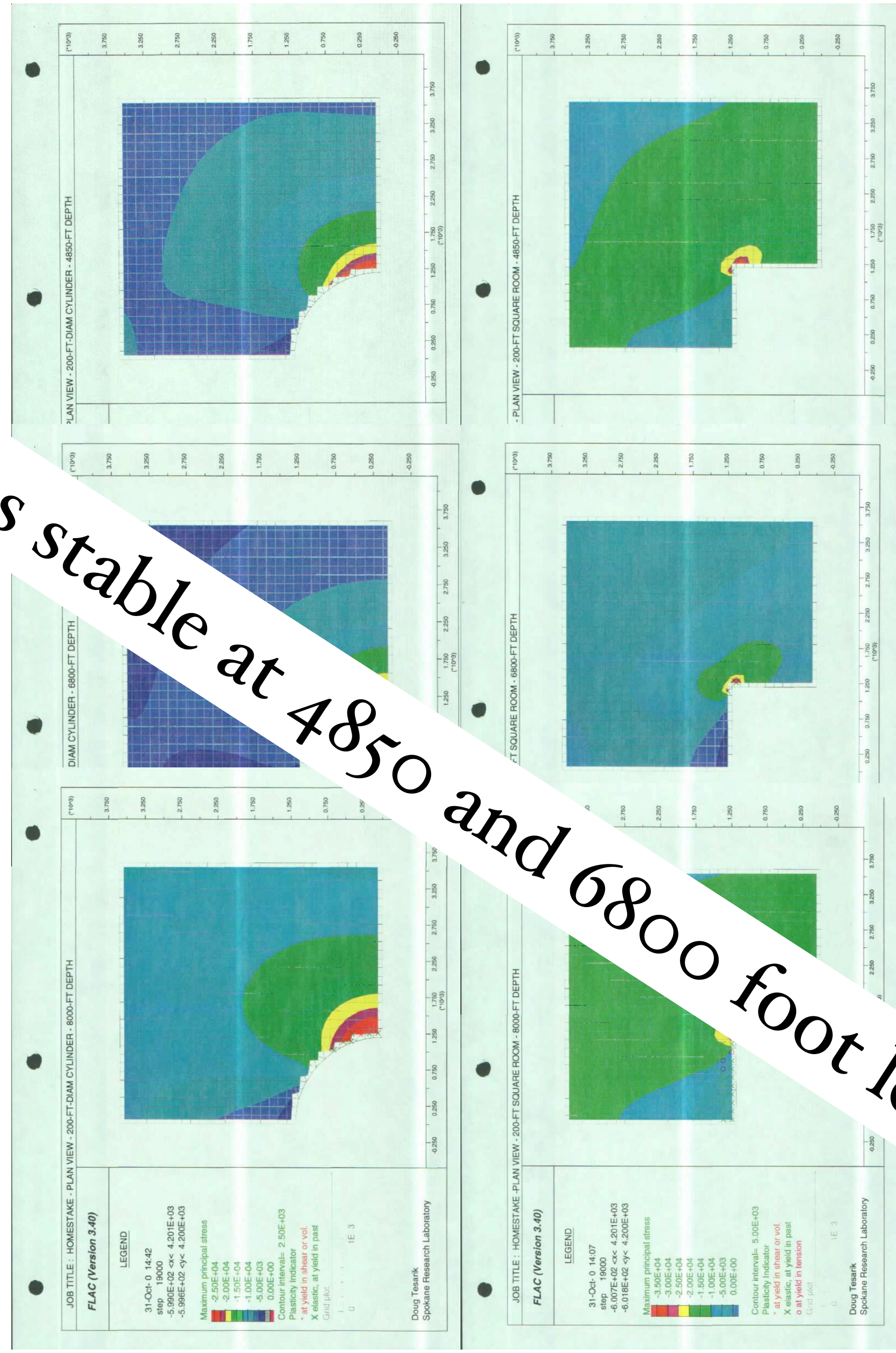
6800 Level
(1.4x10^4 c 1000)

(3.5x10^4 c 2500)

8000 Level
(2.5x10^4 c 2500)

Johnson and Tesarik, 2000

~ Level
(max
stress=1.2x10
@ 1000)



~50 m cavities stable at 4850 and 6800 foot levels

(1.75x10^4
c 2500)

(2.25x10^4
c 2500)

6800 Level
(1.4x10^4 c 1000)

(3.5x10^4
00)

8000 Level
(2.5x10^4 c 2500)

How Long Would it Take?

- Rate depends on how much simultaneous excavations and mine activities exist. Pace is set by underground removal of Rock.
- Multiple "faces" helpful for increasing excavation
- Maximum excavation rate (historically):
  - 800,000 short tons per year (set by lower winze)
- More Realistic Rates:
  - 400,000 to 500,000 stpy
    - ~ 3 to 4 years for an Mega-Ton volume cavity w/ full capacity

From Lesko's presentation to UNO 2002

What Would Excavation Cost at Homestake?

- Figure of Merit
  - 400,000 tons/year at 7400 $37.73/ton
  - 400,000 tons/year at 4850 $34.44/ton
- Excavation, local ground support (bolts, mats, screens), no contingency - Estimate from 2001 Bahcall Technical Subcommittee work (2001)
- 0.5MT detector×2.7×$37×1.15 = $58M
- Includes operating rock disposal costs, but disposal needs some capital as well ($5M guess?)
- Experiment lining (Shotcrete, Liners) are extra, can easily double or triple costs! These are mostly site-independent

From Lesko's presentation to UNO 2002

Figures of Merit - Bahcall Committee

Site	mwe	m	ft	Density	Figure of Merit[g]	Labor Installation Efficiency Factor[k]	Halls	Cavern D	Cost of Operations	$Access[v]	Declared Contingency	Surface Building Costs[z]	Total[aa]
CUNL	1600[e] 1840[f] 3172[a] (3524)[b]	655 1300	2150 4265	2.44	[j]\$11/ton [n]\$23/m^3 [p]\$25/m^2	1.1	\$5.9M[n] 3 halls of 15m x 10m x 100m	See note o	(\$0M) \$2-10M/year[u] (\$0M) \$40M-\$200M over 20 year lifetime	[y]\$43.6M +(\$14.2)	25%	25kft^2 = \$6M +\$10M	\$63.7M (\$104M)
Homestake	6156[a] (6700)[b] 6656[a] (7100)[b]	2255 2438	7400 8000	2.73	\$140/m^3 [h]\$50/ton	1.05-1.1	\$40M[l] for 3 halls of 18m x 18m x 100m	See note o	\$3.8M/year[r] \$76M over 20 year lifetime	\$43M[w]		3 bldg = \$53M 32kft^2; 175kft^2; 41kft^2	\$83M (\$159M)
San Jacinto	A: 5000[d] B: 6000[d] C: 6510[d] D: 7000[d]			2.73	[i]\$73/m^3	1	\$33M[m] 3 halls of 20m x 20m x 100m	\$81.8M[q]	\$2.3M/year[s] \$46M over 20 year lifetime	\$51M[x] \$65M[x] \$82M[x]	25%	\$18kft^2 warehouse + 12k ft^2 lab + \$30kft^2 Admin = \$6.6M	[bb]\$115M (\$161M)
Soudan	2200[c]	710	2300	3.1		1.2		\$70M[t]	\$1M/year[t] \$20M over 20year lifetime	[t]\$21M			

Notes:

a) Derived by nominal density and depth.
b) Takes into account flat surface and muon angular distribution.
c) Experimentally measured.
d) Minimum shield hemisphere radius intersecting mountain surface.
e) Hime, et al.
f) Derived by nominal density and 1000 ft depth of rock, 1150 ft depth of salt, and muon angular distribution.
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From Bahcall Tech. Committee Report 2001

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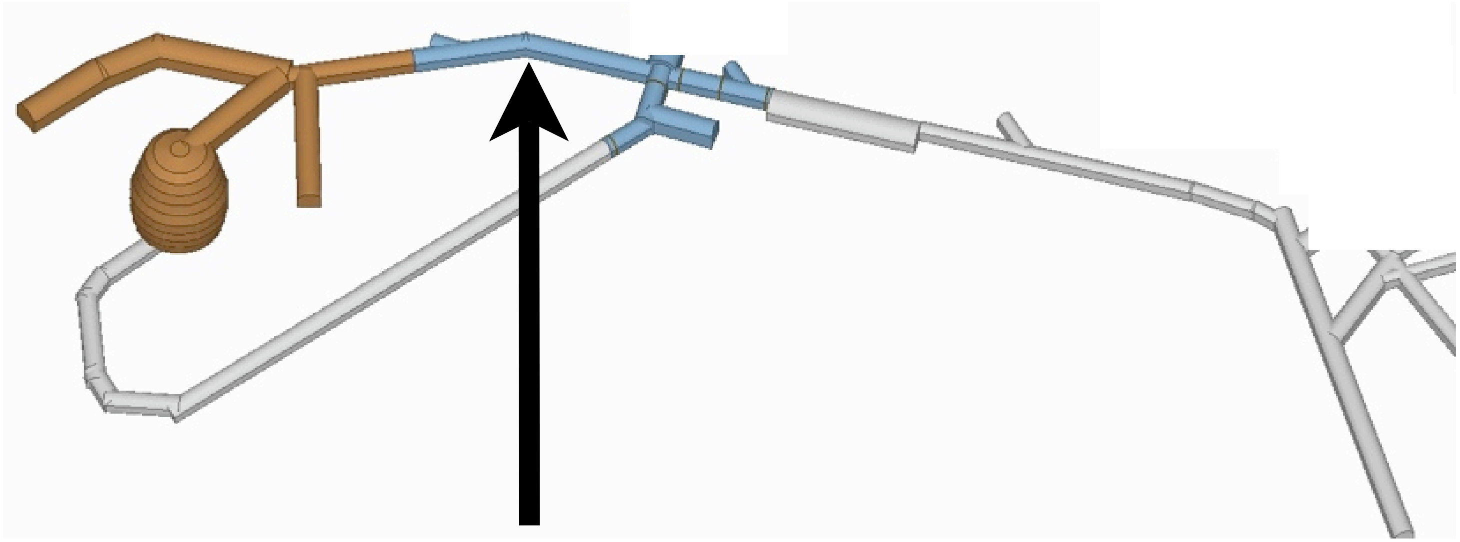
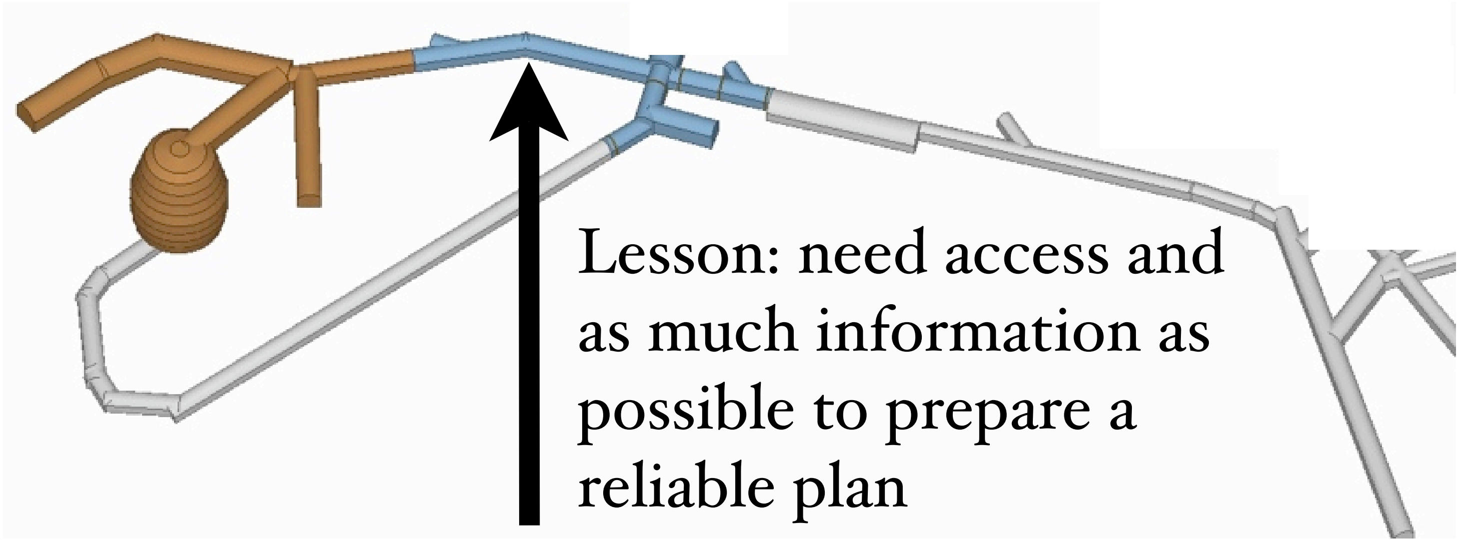


Why the dog-leg at SNO?

• Despite extensive knowledge and a massive design study, a previously unsuspected (hanging wall) was discovered while driving SNO's drift, moved cavity to place within a uniform, *unfeatured* block of rock.

• *Emphasizes* that one can't substitute coring and first-hand geotechnical studies of the actual matrix. For large cavities you mustn't make assumptions about the rock type, geology, ...

• Good to have range of locations and good access, multiple levels



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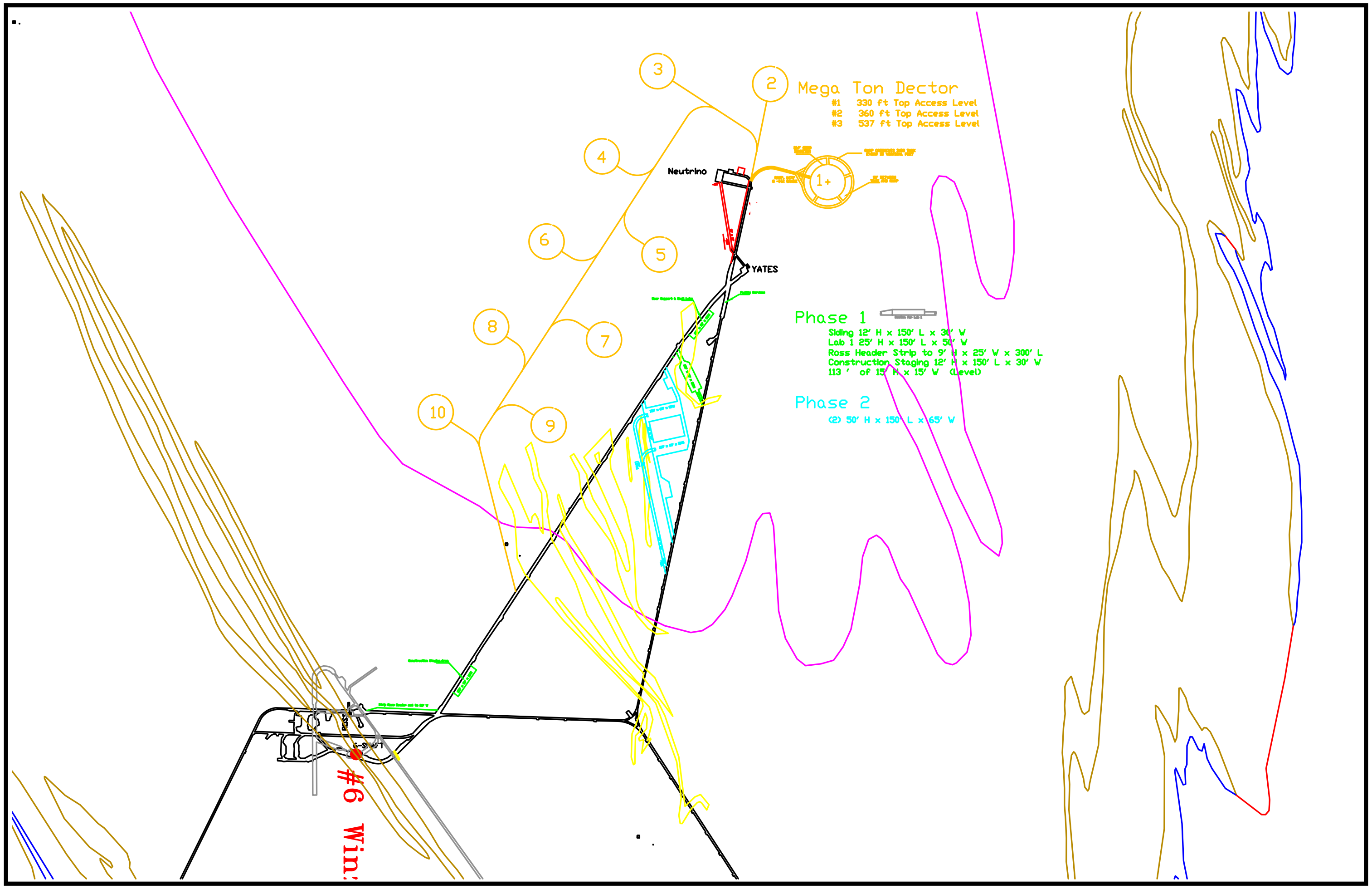
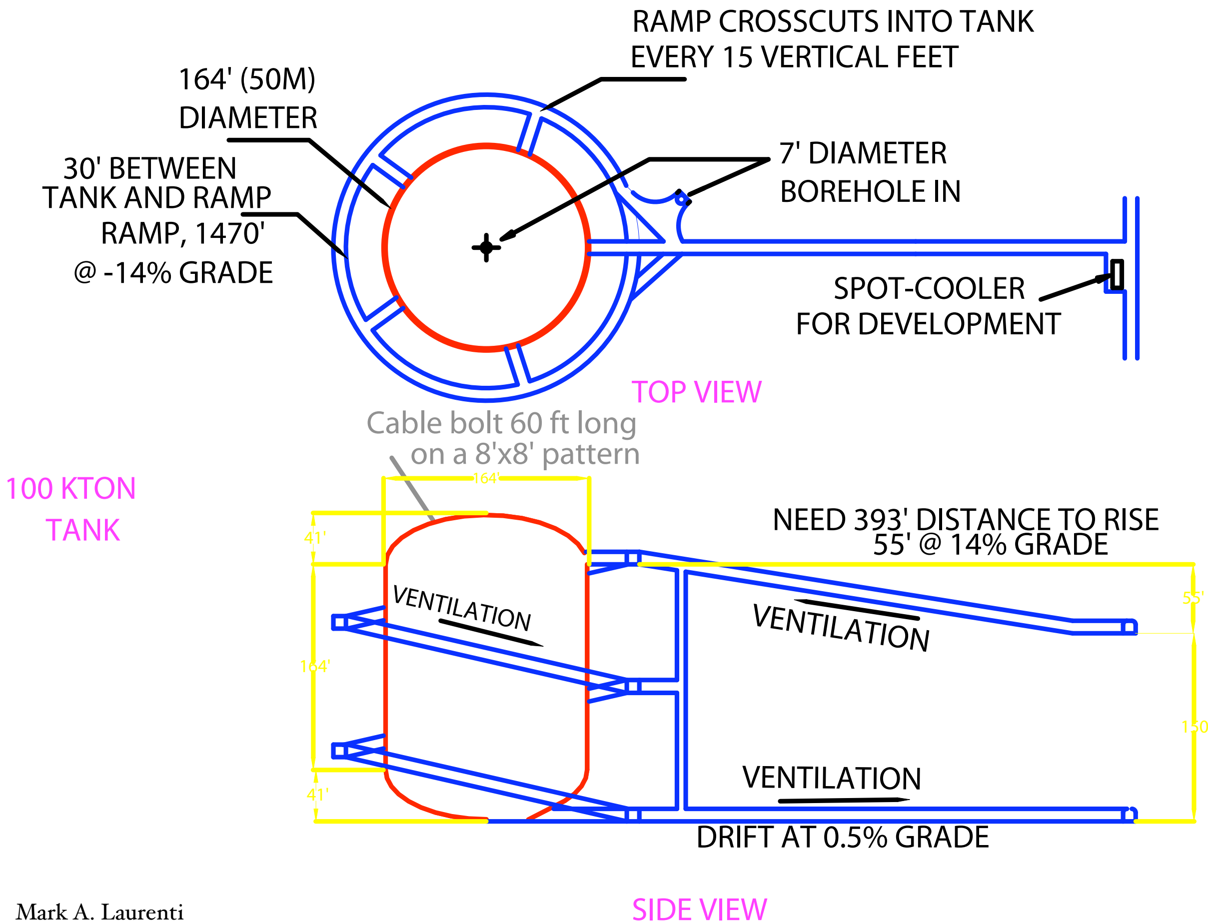
Megaton Cavity Excavation Concepts



Mark A. Laurenti

Megaton Modular Multi-Purpose 100kT Neutrino Detector

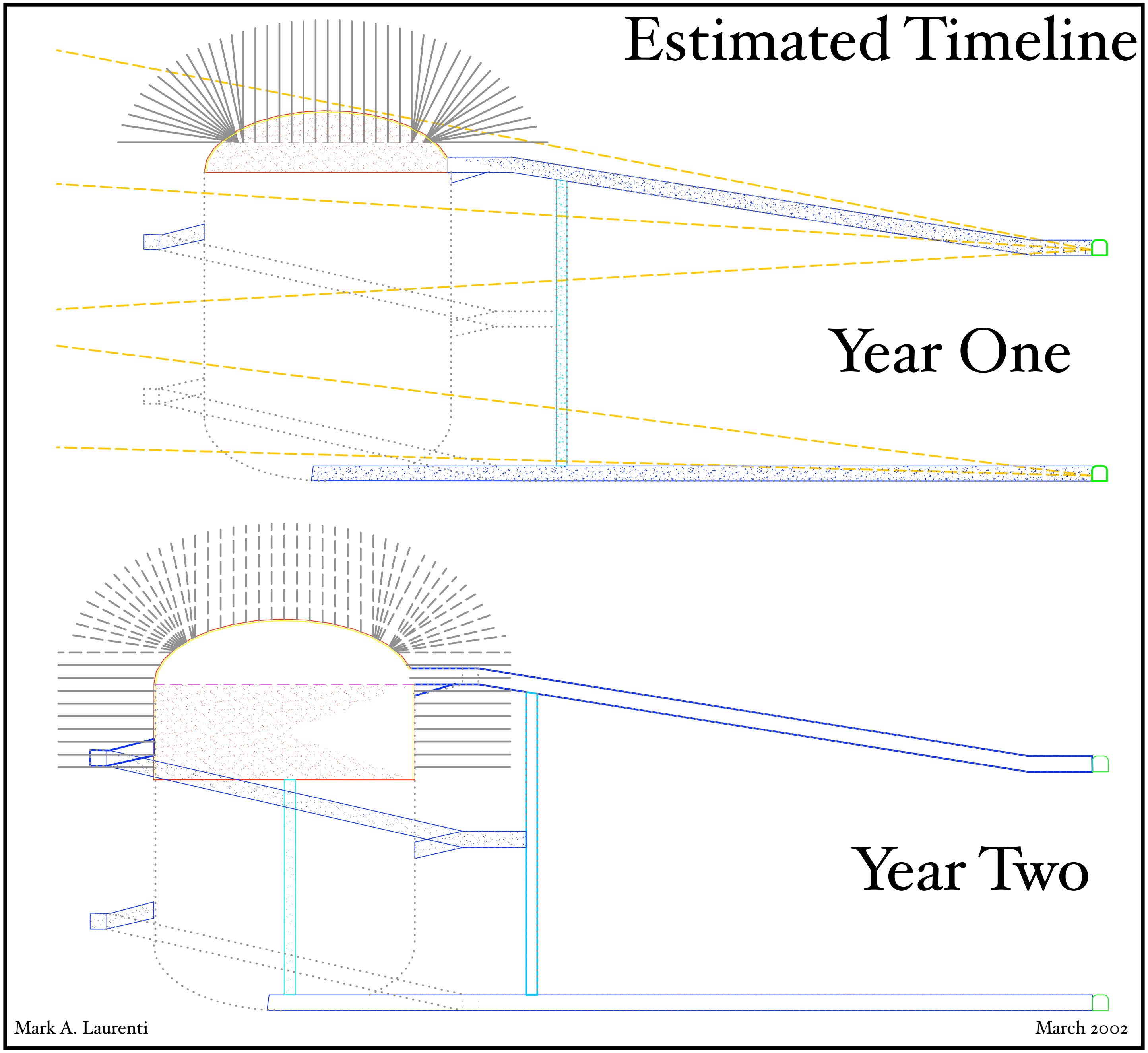
Construction Methodology
(this is one concept, not the only method)

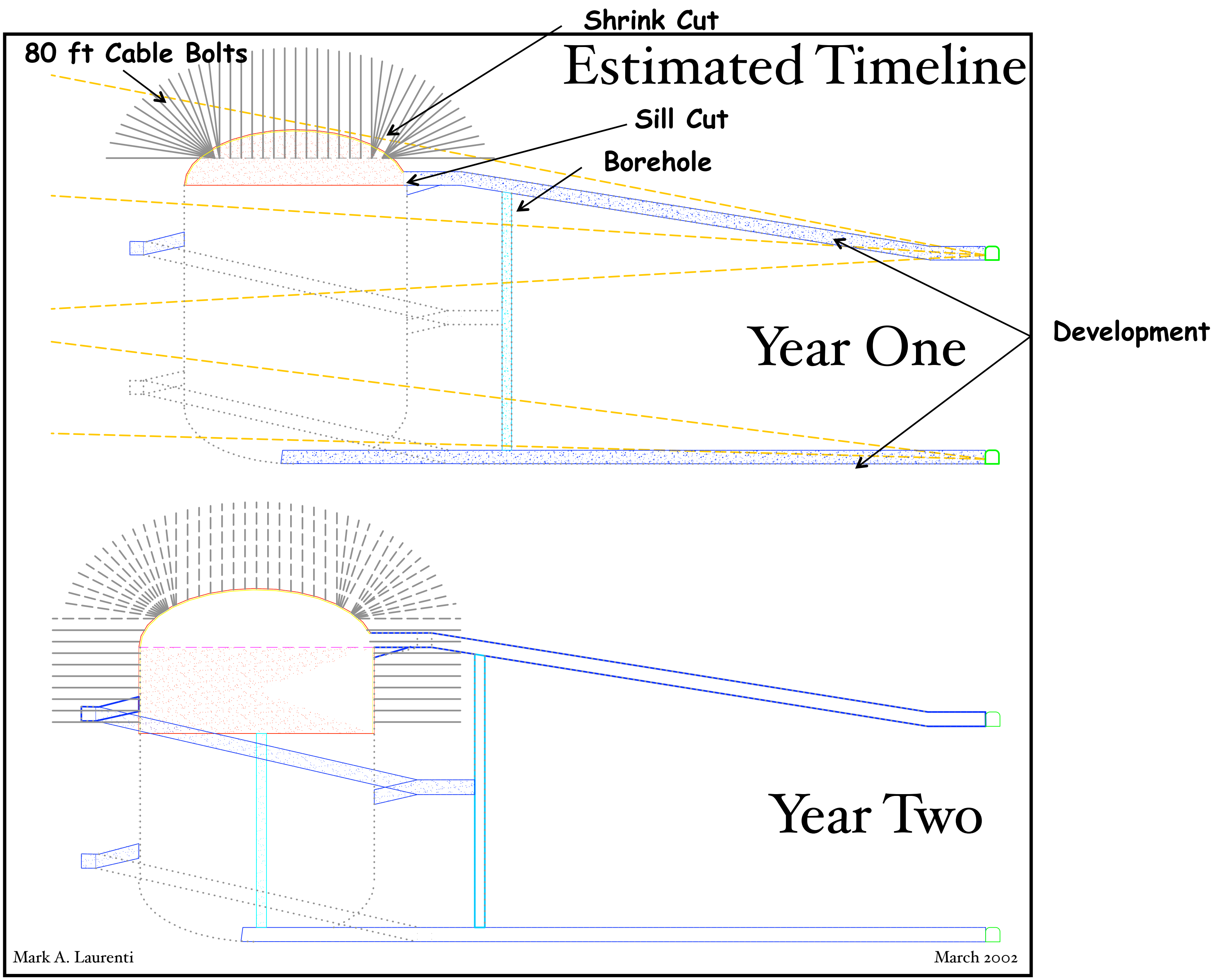


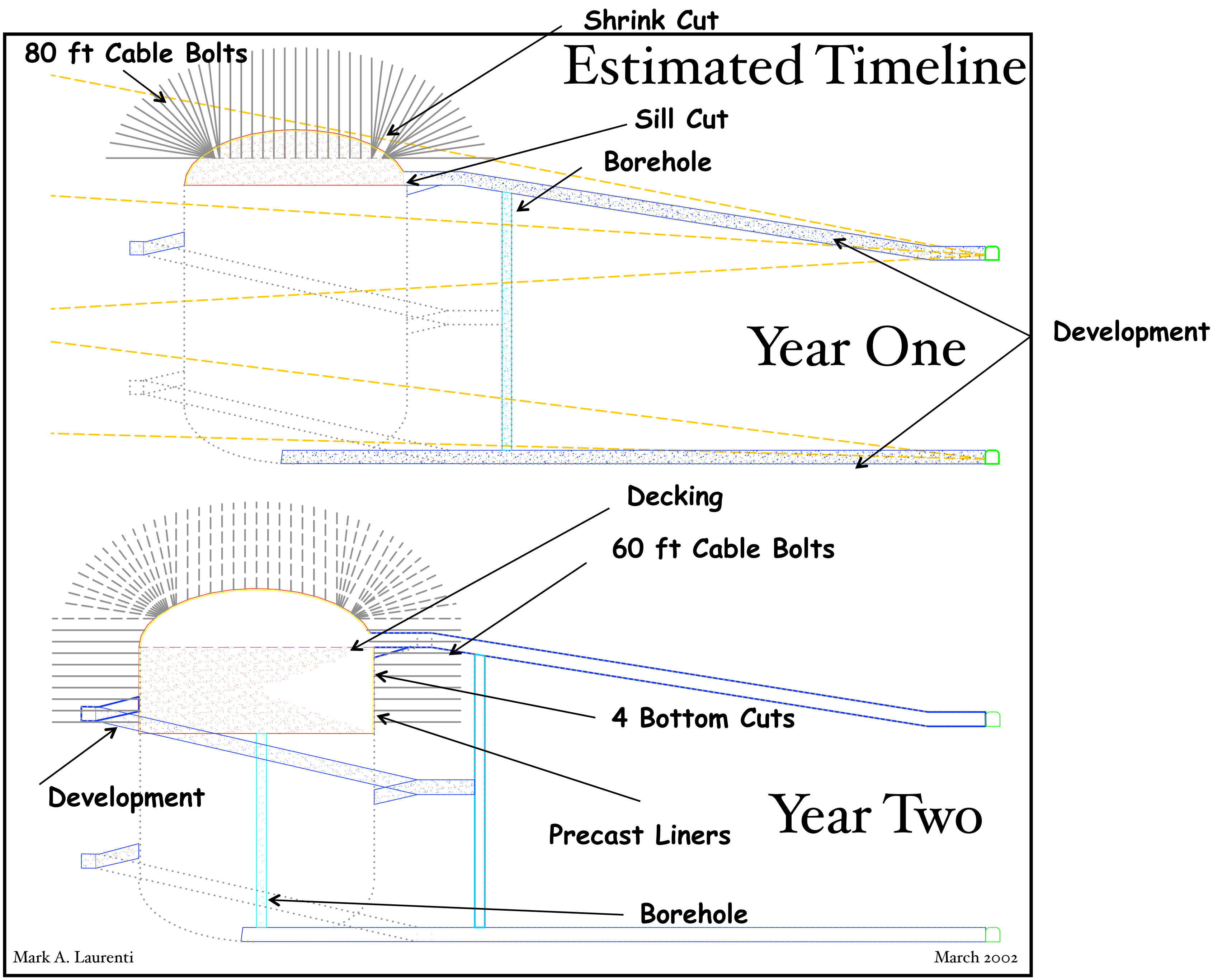
4850

5000

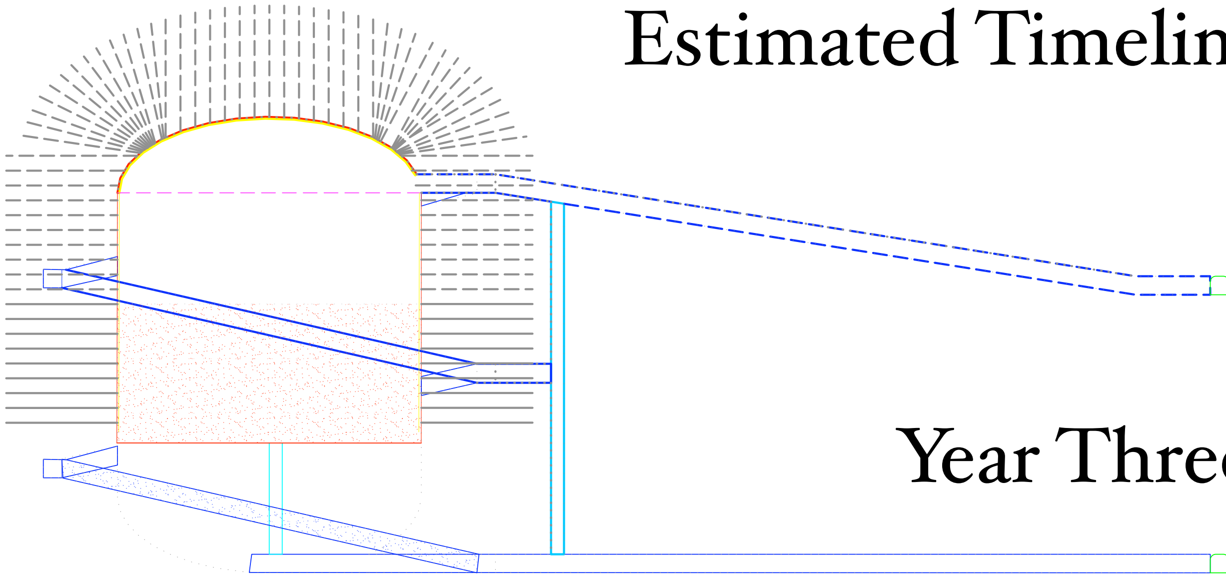
Rock removal would be from the 5000 level, below the main operations


Estimated Timeline
Year One
Year Two
Mark A. Laurenti
March 2002

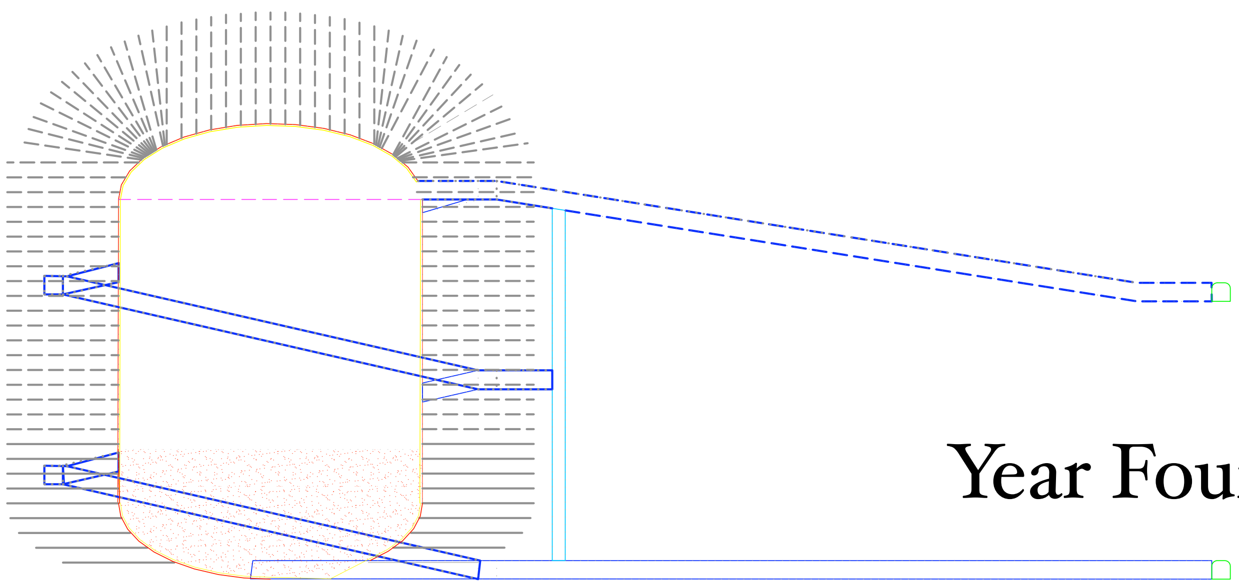

Estimated Timeline
80 ft Cable Bolts
Shrink Cut
Sill Cut
Borehole
Development
Year One
Year Two
Mark A. Laurenti
March 2002


Estimated Timeline
Shrink Cut
80 ft Cable Bolts
Sill Cut
Borehole
Development
Year One
Decking
60 ft Cable Bolts
4 Bottom Cuts
Development
Precast Liners
Year Two
Borehole
Mark A. Laurenti
March 2002

Estimated Timeline

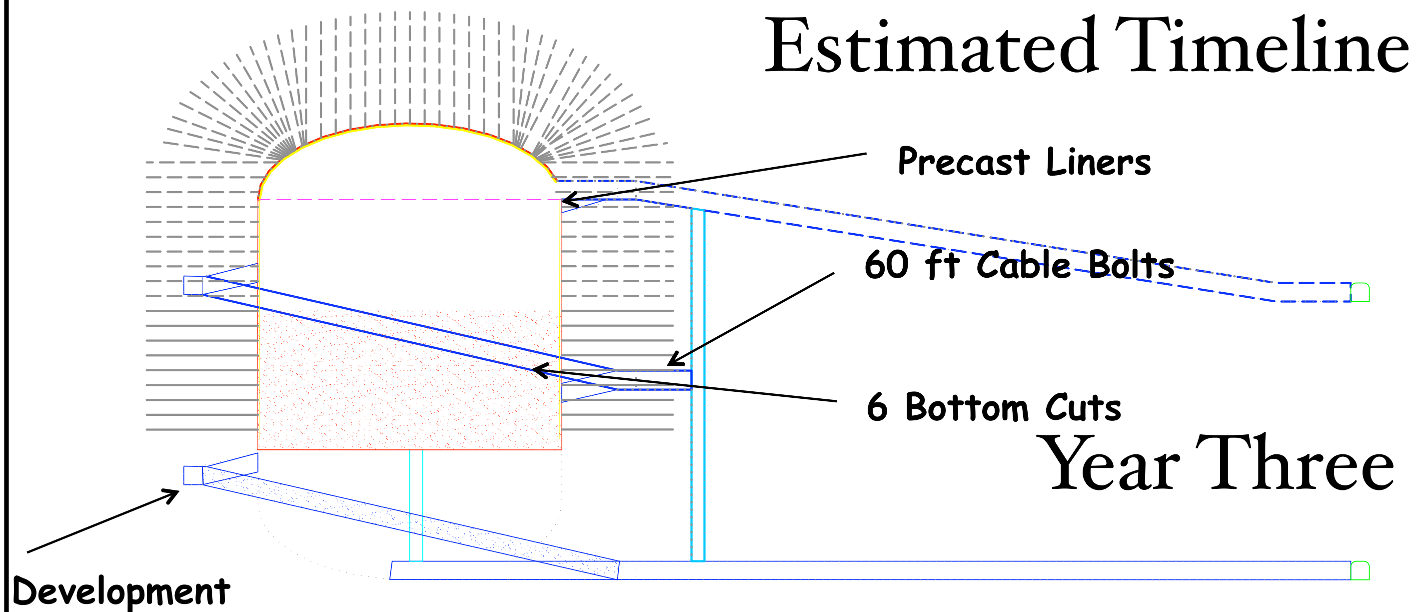


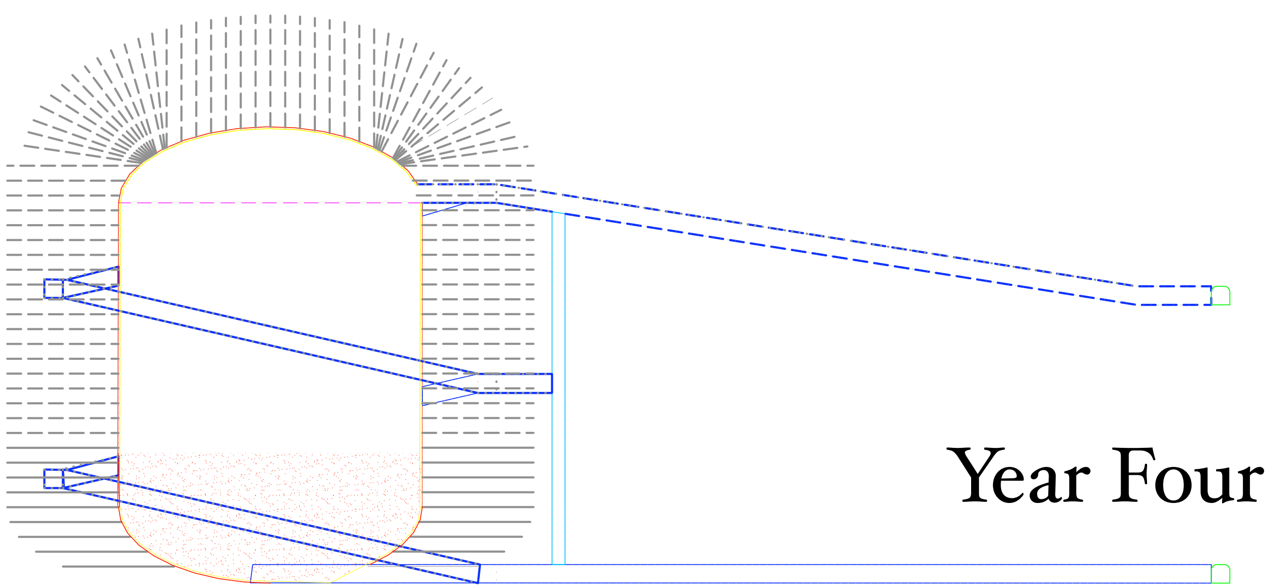
Year Three



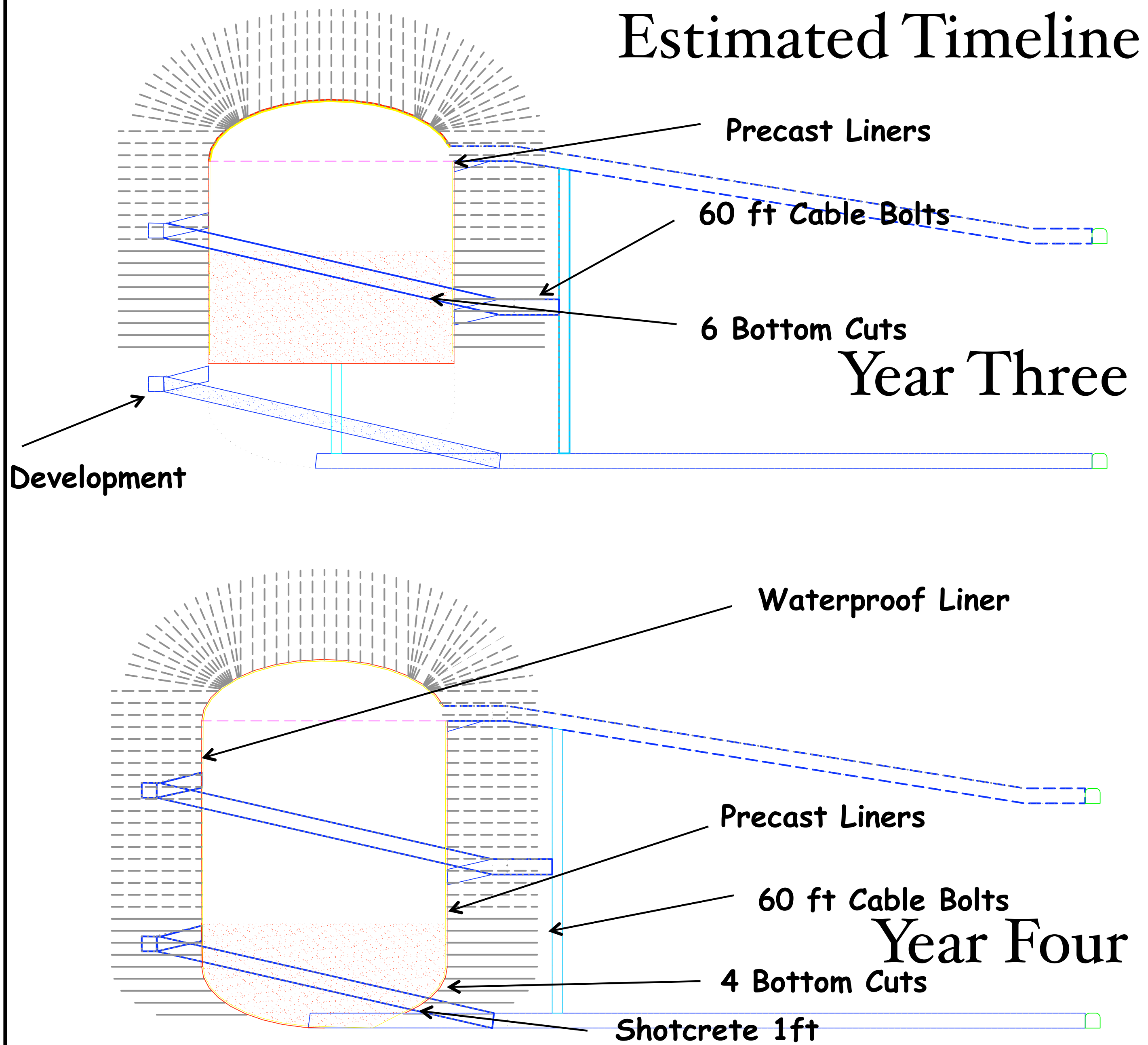
Year Four

Estimated Timeline

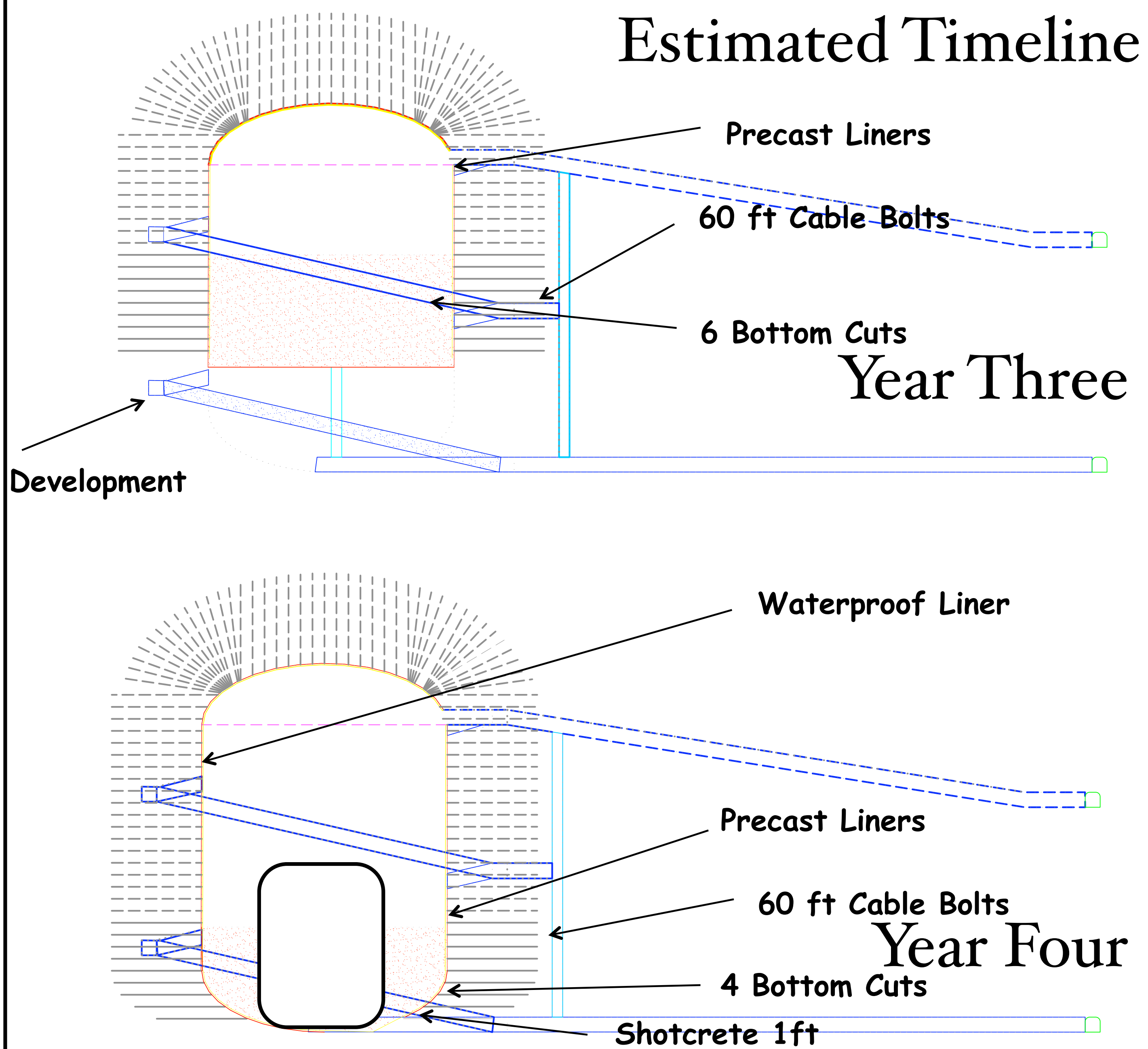




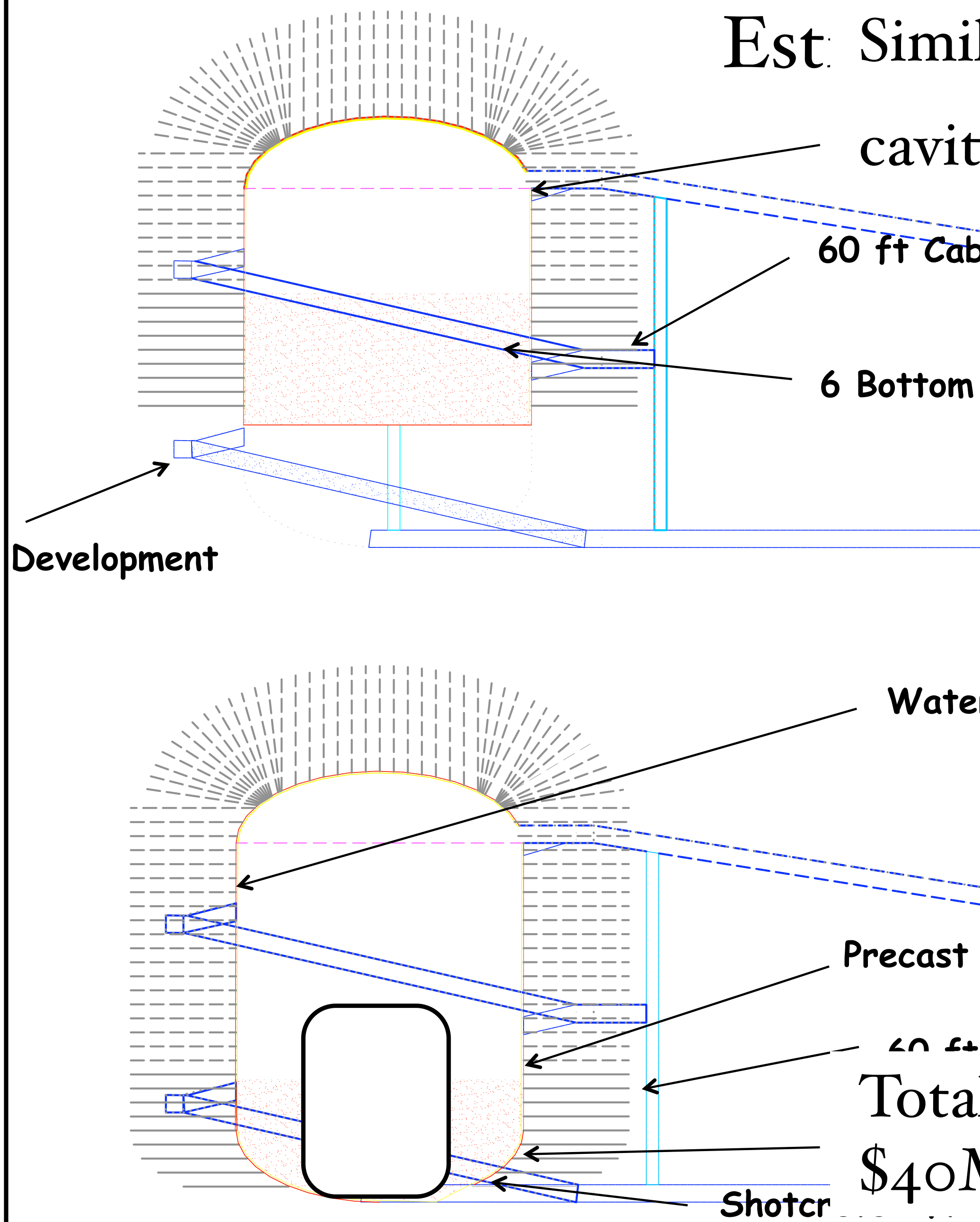
Estimated Timeline



Estimated Timeline



Est Similar to SNO's ∅ 22 m × 35m cavity approach



Total Project Capital Funding $40M (1994$)

Megaton Modular Multi-Purpose 100kT Neutrino Detector

- Estimated construction time for 100kT chamber is *O*~ 4 years

- *Estimated* cost for a 100kT chamber is *O*~ $ 20M + *rock disposal* + *some basic operations (some covered by S.D.) think of this as an excavation estimate, not a detector cavity*
- This is a snapshot of the planning done to date. Any future changes will improve the design and likely reduce the cost and time.
- Existing Core from the 4850 Yates is being identified and analyzed
- We could (would like to?) include cavity characterization in the Initial Suite of Experiments in Homestake, if appropriate. Begin detailed design, geotechnical charaterizations, preparing necessary support in or before 2007.
- It would really help to know what to analyze in detail - converge on a specifications list, need to specify Lab requirements

Homestake Summary

- Interim Laboratory will open for Initial Suite of Experiments (ISE) in 2007, PAC is current working on the ISE, including LOIs for large LAr detector, Water Čerenkov, LS detectors
- Early Program permits a evolutionary and sane approach to developing DUSEL: establishing scientific program, developing the infrastructure and operating staff, phasing of experiments and agency involvement, building confidence and experience
- Initial Studies for Large Cavities exist, much known about the rock and the environment, large operational history to draw on
- Long Baseline Neutrino Program makes sense to initialize with the Early Implementation Program: Cavities could be ready by 2012

2006	2007	2008	2009	2010	2011	2012
Ownership Rehab	Rehab Initial Occupancy	Initial Suite of Expts Cavity R&D	DUSEL $ Cavity Start Deep Lab	Cavity Construct Deep Lab Science	Cavity Construct	Cavity Const. LBL Program Starts - detector development

Homestake Summary

- ☑ No competing uses: Homestake will be dedicated to Science
- ☑ Legal, indemnification, and insurances issues dealt with, status is clear, currently building staff for operations and development
- ☑ Low(er) risk option, fewer unknowns, rapid access to great depths, well characterized site, much already known now
- ☑ Diverse and broad scientific program being established for Homestake and the EIP: makes DUSEL a much easier issue to convince funders, utilizes Homestake's many advantages
- ☑ Science program being established now for a 2007 occupancy, we need to factor in Long Baseline Neutrinos with the other ~ 80 LOIs in designing the lab for this date

Homestake PIs, Senior Personnel & Coordinators

- Yuen-dat Chan, LBNL (Other uses)
- Milind Diwan, BNL (lbl, pdk)
- Reyco Henning, LBNL (oνdbd, dm)
- Ken Lande, Penn (lbl, pdk, geo-neutrinos)
- Bob Lanou, Brown (neutrinos, solar neutrinos)
- Chris Laughton, FNAL (engineering)
- Kevin T. Lesko, UCB (physics) PI
- Stu Loken, LBNL (E+O)
- Hitoshi Murayama, UCB (physics theory, neutrinos)
- Tommy Phelps, ORNL (geomicro)
- Bill Roggenthen, SDSM&T (geophysics) coPI
- Ben Sayler, BHSU (E+O)
- Tom Shutt, Case Western (low backgrounds)
- Nikolai Tolich, LBNL (geonus)
- Bruce Vogelaar, Virginia Tech (solar nus)
- Herb Wang, U Wisc. (geology, rock mechanics)
- Joe Wang, LBNL (earth science, geophysics)

Richard DiGennaro, LBNL, Project Manager and Systems Engineer

Mark Laurenti, Mining Engineer

Syd DeVries, Mining Engineer

Dave Snyder, SDSTA Exec. Director

Trudy Severson, SDSTA

SDSTA Engineering and Safety Personnel

Melissa Barclay & Jeanne Miller